AGRICULTURAL SITUATION IN INDIA

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Agricultural Situation in India

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PART I

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The Journal is brought out by the Directorate of Economics and Statistics, Ministry of Agriculture. It aims at presenting a factual and integrated picture of the Food and Agricultural Situation in India on month to month basis. The views expressed, if any, are not necessarily those of the Government of India.

NOTE TO THE CONTRIBUTORS

Articles on the State of Indian Agriculture and allied sectors are accepted for publication in the Directorate of Economics & Statistics, Department of Agriculture & Cooperation's monthly Journal "Agricultural Situation in India". The Journal intends to provide a forum for scholarly work and also to promote technical competence for research in agricultural and allied subjects. The articles, in hard copy as well as soft copy in MS word, not exceeding five thousand words, may be sent in duplicate, typed in double space on one side of fullscape paper in Times New Roman font size 12, addressed to the Economic & Statistical Adviser, Room No.145, Krishi Bhawan, New Delhi-11 0001, alongwith a declaration by the author(s) that the article has neither been published nor submitted for publication elsewhere. The author(s) should furnish their e-mail address, Phone No. and their permanent address only on the forwarding letter so as to maintain anonymity of the author while seeking comments of the referees on the suitability of the article for publication.

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PART II

STATISTICAL TABLES

Abbreviations used

N.A. —Not Available.
N.Q. —Not Quoted.
N.T. —No Transactions.
N.S. —No Supply/No Stock.
R. —Revised.
M.C. —Market Closed.
N.R. —Not Reported.
Neg. —Negligible.
Kg. —Kilogram.
Q. —Quintal.
(P) —Provisional.
Plus (+) indicates surplus or increase.
Minus (–) indicates deficit or decrease.

A. General Survey

1. Trends in Foodgrain Prices :

During the month of October, 2013, the All India Index Number of Wholesale Price (2004-05=100) of Foodgrains increased by 0.75 per cent from 227.5 in September, 2013 to 229.2 in October. 2013.

The Wholesale Price Index (WPI) Number of Cereals increased of 0.75 percent from 227.9 to 229.6 and WPI of Pulses increased by 0.89 percent from 225.8 to 227.8 during the same period.

The Wholesale Price Index Number of Wheat increased by at 1.67 percent from 210.1 to 213. 6 while that of Rice increased by 1.21 percent from 231.7 to 234.5 during the same period.

2. Weather, Rainfall and Reservoir situation during November, 2013

- Cumulative Post-Monsoon (October to December) Rainfall for the country as a whole during the period 1st October to 27th November, 2013 is 32% more than LP A. Rainfall in the four broad geographical divisions of the country during the above period was higher than LPA by 13% in North West India, 92% in Central Inida, 4% in South Peninsula and 35% in East & North East India.
- Out of a total of 36 meteorological subdivisions, 26 subdivisions received excess/normal rainfall and 10 subdivisions received deficient rainfall.
- Central Water Commission monitors 85 major reservoirs in the country which have a total live capacity of 154.88 BCM at Full Reservoir Level (FRL). Current live storage in these reservoirs as on 28th November, 2013 was 121.39 BCM as against 100.97 BCM on 28-11-2011(last year) and 100.10 BCM of normal storage (average storage of the last 10 years). Current year's storage in 120% of the last year's and 121% of the normal storage.
- As per latest information available on sowing of crops, around 65 % of the normal area under Rabi crops have been sown upto 29-11-2013. Area sown under all rabi crops taken together has been reported to be 395.87 lakh hectares at All India level as compared to 370.35 lakh hectares average area on the corresponding date. Area coverage (as compared to average area) is higher by 24.7 lakh ha. in Wheat, 11.5 lakh ha. in Gram and 3.2 lakh ha. in Rapeseed & Mustard. Area coverage is lower (compared to average area) by (–) 7.3 lakh ha. under Jowar and (–) 1.8 lakh ha. under Sunflower.
- A statement indicating comparative position of area coverage under major Rabi crops during 2013-14 (upto 29-11-2013) and the corresponding period of last year is given in the following table.

TABLE 1—ALL INDIA CROP SITUATION - RABI (2013-14) AS ON 29-11-2013

Crop Name	Normal Area	Average Area as on date	Area sown reported (in lakh hectares)			Absolute Change over (+/–)	
			29-11-2013	% of Normal	29-11-2012	Average as on date	Last Year
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Wheat	286.36	154.78	179.44	62.7	158.46	24.7	21.0
Rice	44.30	1.11	1.06	2.4	0.87	– 0.1	0.2
Jowar	42.77	39.32	32.01	74.8	35.65	– 7.3	– 3.6
Maize	12.30	4.69	3.91	31.8	5.10	– 0.8	– 1.2
Barley	6.56	4.98	4.07	62.0	4.79	– 0.9	– 0.7
Total Coarse Cereals	61.63	49.35	40.45	65.6	46.15	– 8.9	– 5.7
Total Cereals	392.29	205.24	220.95	56.3	205.48	15.7	15.5
Gram	82.18	63.96	75.48	91.8	72.40	11.5	3.1
Lentil	14.64	11.38	11.27	77.0	10.81	– 0.1	0.5

TABLE 1—ALL INDIA CROP SITUATION - RABI (2013-14) AS ON 29-11-2013

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Peas	7.16	6.29	6.30	88.0	6.33	0.0	0.0
Kulthi(Horse Gram)	2.10	3.65	3.64	172.8	3.57	0.0	0.1
Urad	7.61	2.36	1.83	24.1	2.36	– 0.5	– 0.5
Moong	6.66	1.01	0.83	12.4	0.89	– 0.2	–0.1
Lathyrus	5.16	3.04	2.48	48.0	2.86	–0.6	– 0.4
Others	3.45	3.32	3.15	91.4	3.27	–0.2	– 0.1
Total Pulses	128.97	95.01	104.97	81.4	102.49	10.0	2.5
Total Foodgrains	521.26	300.25	325.92	62.5	307.97	25.7	17.9
Rapeseed & Mustard	61.01	57.55	60.74	99.5	57.16	3.2	3.6
Groundnut	9.09	2.39	2.45	27.0	2.51	0.1	– 0.1
Safflower	2.79	1.92	1.21	43.3	1.16	– 0.7	0.1
Sunflower	8.59	4.68	2.85	33.1	3.39	– 1.8	– 0.5
Sesamum	2.50	0.35	0.37	14.9	0.24	0.0	0.1
Linseed	3.80	2.69	2.00	52.6	2.17	– 0.7	– 0.2
Others	0.00	0.52	0.34	#DIV/01	0.28	– 0.2	0.1
Total Oilseed (Nine)	87.79	70.10	69.96	79.7	66.90	– 0.1	3.1
All-Crops	**609.05**	**370.35**	**395.87**	**65.0**	**374.87**	**25.5**	**21.0**

Agriculture :

All India production of foodgrains: As per the 1st advance estimates released by Ministry of Agriculture on 24-09-2013, production of Kharif foodgrains during 2013-14 is estimated at 129.32 million tonnes compared to 117.18 million.tonnes (1st advance estimates) in 2012-13.

Procurement : During the Kharif Marketing Season 2012-13, which spanned from October 2012 to September 2013, the procurement of rice was 34.02 million tonnes (as on 1st October 2013) as against 34.92 million tonnes procured last year in the corresponding period. This represents a decrease of 2.58 per cent. Wheat procurement during Rabi Marketing Season 2013-14, which spans from April 2013 to March 2014, is 25.09 million tonnes as on 1st August 2013.

TABLE 2— PROCUREMENT IN MILLION TONNES

	2010-11	2011-12	2012-13	2013-14
Rice	34.20	35.04	34.02	10.56#
Wheat	22.51	28.34	38.15	25.09*
Total	**56.71**	**63.38**	**72.17**	**35.65**

* Position as on 1-8-2013.
#Position as on 20-11-2013

Off-take: Off-take of rice during the month of September, 2013 was 25.19 lakh tonnes. This comprises 20.94 lakh tonnes under TPDS and 4.25 lakh tonnes under other schemes. In respect of wheat, the total off take was 20.85 lakh tonnes comprising of 18.26 lakh tonnes under TPDS and 2.59 lakh tonnes under other schemes.

Stocks : Stocks of foodgrains (rice and wheat) held by FCl as on November 1, 2013 were 50.95 million tonnes, which is lower by 26.72 percent over the level of 69.53 million tonnes as on November 1, 2012.

TABLE 3—OFF-TAKE AND STOCKS OF FOODGRAINS (MILLION TONNES)

	Off-take			Stocks	
	2011-12	2012-13	2013-14 upto Sept. 2013)	Nov. 1, 2012	Nov. 1, 2013
Rice	32.12	32.64	14.39	28.95	16.85
Wheat	24.26	33.21	12.32	40.58	34.10
Total	**56.38**	**65.85**	**26.71**	**69.53**	**50.95**

P=Provisional

Growth of Economy —

As per the latest Estimates of the Central Statistics Office (CSO), the growth in Gross Domestic Product (GDP) at factor cost at constant (2004-05 prices) was estimated at 5.0 per cent in 2012-13 with agriculture, industry and services registering growht rates of 1.9 per cent, 2.1 per cent and 7.1 per cent respectivley. The growth in GDP was placed at 4.4 per cent and 4.8 per cent respectively in the first and second quarters of 2013-14.

TABLE 4— GROWTH OF GDP AT FACTOR COST BY ECONOMIC ACTIVITY

(at 2004-05 Prices)

Sector	Growth			Percentage Share in GDP		
	2010-11	2011-112 1R	2012-13 (PE)	2010-11	2011-12 1R	2012-13 (PE)
1. Agriculture, forestry and fishing	7.9	3.6	1.9	14.5	14.1	13.7
2. Industry	**9.2**	**3.5**	**2.1**	**28.2**	**27.5**	**26.7**
a. Mining and quarrying	4.9	– 0.6	– 0.6	2.2	2.1	2.0
b. Manufacturing	9.7	2.7	1.0	16.2	15.7	15.1
c. Electricity, gas and water supply	5.2	6.5	4.2	1.9	1.9	1.9
d. Construction	10.2	5.6	4.3	7.9	7.9	7.8
3. Services	**9.8**	**8.2**	**7.1**	**57.3**	**58.4**	**59.6**
a. Trade, hotels, transport and communication	12.3	7.0	6.4	27.3	27.5	27.8
b. Financing, insurance, real estate and business services	10.1	11.7	8.6	17.2	18.1	18.7
c. Community, social and personal services	4.3	6.0	6.6	12.8	12.8	13.0
4. GDP at factor cost	**9.3**	**6.2**	**5.0**	**100.00**	**100.00**	**100.00**

1R : 1st Revised Estimates; PE : Provisional Estimates. *Source :* CSO.

TABLE 5—QUARTERLY GROWTH RATE OF GDP (PER CENT)

(per cent)

Sector	2011-12				2012-13				2013-14	
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2
1. Agriculture, forestry & fishing	5.4	3.2	4.1	2.0	2.9	1.7	1.8	1.4	2.7	4.6
2. Industry	5.7	3.8	2.6	2.1	1.8	1.3	2.5	2.7	0.2	2.4
1. Mining & quarrying	– 0.4	– 5.3	– 2.6	5.2	0.4	1.7	– 0.7	– 3.1	– 2.8	– 0.4
b. Manufacturing	7.4	3.1	0.76	0.1	– 1.0	0.1	2.5	2.6	– 1.2	1.0
c. Electricity, gas & water supply	6.6	8.4	7.7	3.5	6.2	3.2	4.5	2.8	3.7	7.7
d. Construction	3.8	6.5	6.9	5.1	7.0	3.1	2.9	4.4	2.8	4.3
3. Services	**8.9**	**8.5**	**8.3**	**7.3**	**7.7**	**7.6**	**6.7**	**6.6**	**6.6**	**5.9**
a. Trade, hotels, transport & communication	9.5	7.0	6.9	5.1	6.1	6.8	6.4	6.2	3.9	4.0
b. Financing, insurance, real estate & buss. Services	11.6	12.3	11.4	11.3	9.3	8.3	7.8	9.1	8.9	10.0
c. Community, social & personal services	3.5	6.5	6.8	6.8	8.9	8.4	5.6	4.0	9.4	4.2
4. GDP at factor cost	**7.5**	**6.5**	**6.0**	**5.1**	**5.4**	**5.2**	**4.7**	**4.8**	**4.4**	**4.8**

Source: CSO

B. Articles

Magnitude and Determinants of Indebtedness among Women Labour Households in Rural Punjab : District-wise Analysis

DHARAM PAL* AND GIAN SINGH**

Abstract

The present study attempts to highlight the variations in the debt position and determines the factors influencing the indebtedness among the sampled women labour households in the rural areas of the sampled districts in Punjab. The data were collected from 498 households of three districts, namely, Sangrur, Ludhiana and Hoshiarpur, selected on the basis of work participation rate of rural women in Punjab by using multi-stage systematic random sampling technique. The study relates to the year 2010-11. The study reveals that a large majority of the sampled women labour households are under debt in the rural areas of Punjab. The indebted sampled women labour households range from 88.12 per cent in Hoshiarpur district to 96.32 per cent in Sangrur district. The corresponding proportion in Ludhiana district is 95.65 per cent. Further, the sampled women labour households, on an average, in Ludhiana district take 85.21 per cent of the loans from the non-institutional sources, while the corresponding figures for Sangrur and Hoshiarpur districts are 82.65 per cent 70.81 per cent respectively. It is pertinent to note that the sampled women labour households, on an average, are spending the maximum proportion of loans for productive purposes in all the districts under study. It is deplorable to note that 75.29 per cent of loans are incurred by the sampled women labour households in Ludhiana district at more than 24 per cent rate of interest per annum. The corresponding proportions for Sangrur and Hoshiarpur districts are 71.37 per cent and 48.38 per cent respectively. It has been found that the factors such as educational level of the decision-maker in the family, ratio of the earning of female labourers to male counterpart in the family and total household income have a negative regression coefficient which indicates that these factors have a negative relationship with indebtedness in all the three sampled districts. On other hand, the factors such as ratio of credit from non-institutional sources to that from institutional sources, expenditure on unproductive purposes, total household expenditure and value of total household assets have a positive relationship with indebtedness in all the districts under study. The regression coefficient of the factor, viz. family-size is found to be negative in Sangrur district which indicates a negative relationship with indebtedness. However, this factor has appeared with positive values in Ludhiana and Hoshiarpur districts. Another factor, i.e., number of females in the family is found to be positive in Hoshiarpur district. However, this factor has a negative relationship with indebtedness in Sangrur and Ludhiana districts.

According to Census 2011, 68.84 per cent of people in India were rural. Within rural India, agriculture continues to still be the dominant occupation which provides more than half workforce employment. The phenomena of under-development, under-employment and surplus population are simultaneously manifested in the daily lives of the agricultural labourers (Padhi, 2007). They get less and irregular wage and maintain lower living style remaining below poverty line. This is so because of the stagnation or slow growth in the agriculture sector and jobless growth in the non-agriculture sector (Singh and Pal, 2011). Although, 'Green Revolution' has given our country self-sufficiency in the agriculture sector, yet its benefits have not been reached to the agricultural labourers especially the women labourers (Mishra, 2008). With the adoption of policies of globalization in India, the employment opportunities are likely to be further reduced as they have to suffer stiff competition from foreign technology and modern methods of agriculture (Jaiswal, 2009).

The most important task of planned development India is to raise the living standard of people through increased employment and income (Kaur and Singh, 2013). Even our national leaders and the successive governments have brought about a number of reforms with the specific objective of alleviating the poverty of the downtrodden masses especially in the backward communities. Despite all these efforts, it is found that even now they continue to remain marginalized from enjoying the fruits of development (Mathew, 2003). Even in a state like Punjab which boasts of a unique development experience, with social indicators like literacy, birth rate, death rate and health status, the women labour class, especially those living in the rural areas is still experiencing levels of living much below that of the general population. Rural labour

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households are characterized by declining earning, low income, low consumption and high debt (Mahapatra, 2010). The recent study shows that the daily per capita income of 68 per cent of households dependent on agricultural wage labour is less than or equal to only Rs. 10. As a result of low wages and low family earnings, about 70 per cent of labourers are living under debt. Employment in agriculture is casual, intermittent and uncertain and labourers find it most difficult in making both ends meet at this consistently low level of living (Singh, 2009). In this paper, an attempt has been made to assess and analyse the debt position of the sampled women labour households in the rural areas of the sampled districts in Punjab. More specifically, the aims are:

1. to estimate the debt position of the sampled women labour households;
2. to analyse the debt level of the women labour households according to the sources, rate of interest, purposes and range of indebtedness; and
3. to determine and signify the factors influencing indebtedness among the sampled women labour households.

Data and Methodology

The present study, based on multi-stage systematic random sampling technique, relates to the year 2010-11. For the purpose of this study, the whole state is divided into three zones of districts on the basis of work participation rate of rural women in Punjab (Table 1). One district from each zone was selected on an average basis. Sangrur district represents the high work participation zone, while Ludhiana and Hoshiarpur districts represent the medium and low work participation zones respectively.

TABLE 1—DISTRICT-WISE WORK PARTCIPATION RATE OF RURAL WOMEN IN PUNJAB

Sl. No.	District	Rural woman workers	Total rural women population	Work partici-pation rate
High Work participation zone				
1.	Nawan Shahr	86,170	2,41,887	35.62
2.	Bhatinda	1,33,494	3,87,423	34.46
3.	Sangrur	1,97,085	6,58,756	29.92
4.	Rupnagar	1,03,229	3,50,554	29.45
5.	Mansa	73,674	2,55,566	28.82

TABLE 1—DISTRICT-WISE WORK PARTICIPATION RATE OF RURAL WOMEN IN PUNJAB—*Contd.*

Sl. No.	District	Rural woman workers	Total rural women population	Work partici-pation rate
Medium work participation zone				
6.	Muktsar	74,788	2,72,859	27.41
7.	Moga	91,179	3,36,892	27.06
8.	Faridkot	43,118	1,68,378	25.61
9.	Ludhiana	1,55,451	6,26,585	24.81
10.	Fatehgarh Sahib	40,751	1,79,013	22.76
11.	Ferozepur	1,36,610	6,11,512	22.34
Low work partcipation zone				
12.	Amritsar	1,86,529	8,79,171	21.22
13.	Patiala	1,14,426	5,57,591	20.52
14.	Hoshiarpur	1,11,678	5,77,987	19.32
15.	Kapurthala	39,303	2,42,021	16.24
16.	Jalandhar	75,721	4,91,696	15.40
17.	Gurdaspur	1,08,123	7,42,001	14.57
	Punjab	**1,771,302**	**77,579,892**	**23.52**

Source : Census of India, 2001.

From the list of villages in each development block in each of the selected districts, one village was selected randomly. From these villages, a comprehensive list of the women labour households was prepared. From this list, 10 per cent of the households were selected randomly. In all 498 households were selected for the survey. These 498 selected households were visited personally to collect information on the various socio-economic aspects of their families. Information was recorded by personal interview method on pre-tested structured questionnaire designed for the purpose. To analyse the data, apart from using the mean values and percentages, the following multiple regression analysis is also used:

$$Y=a+b_1 X_1+b_2 X_2+b_3X_3+b_4 X_4+b_5X_5+b_6X_6+b_7 X_7+b_8 X_8+b_9 X_9+\mu 1$$

Where

Y = Indebtedness (in Rs.)

X_1 = Family-size

X_2 = Ratio of credit from the non-institutional sources to that from the institutional sources

X_3 = Number of females in the family

X_4 = Expenditure on unproductive purposes (in Rs.)

X_5 = Educational level of the decision-maker in the family

X_6 = Ratio of the earning of female labourers to male counterpart in the family

X_7 = Total household income (in Rs.)

X_8 = Total household consumption (in Rs.)

X_9 = Value of total household assets (in Rs.)

$\mu 1$= A random error term

b_1 to b_{10} = Regression coefficients of independent variables

This analysis is used to determine and signify the factors influencing indebtedness among the women labourer households in the rural areas of the sampled districts in Punjab.

Empirical Findings

Magnitude of Indebtedness

The data showing the extent of district-wise indebtedness is presented in Table 2. The table brings out that the proportion of indebted households range from 88.12 per cent in Hoshiarpur district to 96.32 per cent in Sangrur district. The corresponding proportion in Ludhiana district is 95.65 per cent. The table further reveals that the amount of debt per sampled household ranges from Rs. 19,796.60 in Hoshiarpur district to Rs. 28,748.95 in Ludhiana district. However, in the case of Sangrur district, the indebtedness per sampled household is Rs. 24,758.93. The amount of debt per indebted household has also shown a similar trend. It is the highest, i.e., Rs. 30,055.72 in Ludhiana district and the lowest, i.e., Rs. 22,465.81 in Hoshiarpur district. The corresponding figure for Sangrur district is Rs. 25,705.99.

TABLE 2—EXTENT OF INDEBTEDNESS AMONG SAMPLED WOMEN LABOUR HOUSEHOLDS : DISTRICT-WISE

Particulars	Sangrur District	Ludhiana District	Hoshiarpur District
Sampled households (number)	190	207	101
Indebted households (number)	183	198	89
Percentage of Indebted households	96.32	95.65	88.12
Amount of Debt per sampled household (in Rs.)	24,758.93	28.748.95	19,796.60
Amount of debt per indebted households (in Rs.)	25,705.99	30,055.72	22,465.81

Source : Field Survey, 2010-11

Indebtedness according to Source of Credit

The role of various credit sources has been studied in the sampled districts of Punjab and such data is presented in Table 3. The pattern revealed by the table is similar to the one presented for Punjab state as a whole. The sampled women labour households in all the sampled districts avail maximum amount of loans from the non-institutional sources. The amount of loan from non-institutional sources is the highest, i.e., Rs. 24,498.38 in Ludhiana district and the lowest, i.e., Rs. 14,018.36 in the Hoshiarpur district. However, a reverse trend has been observed in the case of institutional sources. The amount of loan from institutional sources is the highest, i.e., Rs. 5,778.25 in Hoshiarpur district and the lowest, i.e., Rs. 4,250.57 in Ludhiana district. In Sangrur district, an average sampled woman labour household has taken a loan of Rs. 20,463.47 from non-institutional sources, while Rs. 4,295.46 from institutional sources.

TABLE 3—LEVELS AND PATTERN OF DEBT INCURRED FROM DIFFERENT CREDIT SOURCES : DISTRICT-WISE

(Mean Values in Rs.)

Sl. No.	Source of credit	Amount of Debt		
		Sangrur district	Ludhiana district	Hoshiarpur district
A.	**Non-institutional sources**			
1.	Large farmers and landlords	15,385.50 (62.14)	18,483.91 (64.29)	8,225.44 (41.55)
2.	Money-lenders	1,992.73 (8.05)	2,667.82 (9.28)	1,559.80 (7.88)
3.	Cloth merchants and grocers	2,892.73 (11.68)	3,087.36 (10.74)	3,873.16 (19.56)
4.	Relatives and friends	192.51 (0.78)	259.30 (0.90)	359.96 (1.82)
	Sub-total	**20,463.47 (82.65)**	**24,498.38 (85.21)**	**14,018.36 (70.81)**
B.	**Institutional sources**			
1.	Co-operative credit societies/banks	1,684.55 (6.80)	1,309.20 (4.56)	2,096.06 (10.59)
2.	Commercial banks	2,601.91 (10.55)	2,941.38 (10.23)	3,682.19 (18.60)
	Sub-total	**4,295.46 (17.35)**	**4,205.57 (14.79)**	**5,778.25 (29.19)**
	Total (A + B)	**24,758.93 (100.00)**	**28,748.95 (100.00)**	**19,796.60 (100.00)**

Source : Field Survey, 2010-11.

Note : The figures given in parentheses denote percentage

The pattern of debt depicts that an average sampled woman labour household in Ludhiana district avails 85.21 per cent of loans from the non-institutional sources, while the corresponding figures for Sangrur and Hoshiarpur districts are 82.65 per cent 70.81 per cent respectively. Larger farmers and landlords appear to be the largest contributor towards loans in all the three sampled districts. This proportion is the highest in Ludhiana district (64.29 per cent) followed by Sangrur (62.14 per cent) and Hoshiarpur (41.55 per cent) districts. The proportionate share of institutional sources is as high as 29.19 per cent in Hoshiarpur district and as low as 14.79 per cent Ludhiana district. The commercial banks appear at the first place in providing loans to the sampled households in all the districts under study. This proportion is the highest (18.60 per cent) in Hoshiarpur district followed by Sangrur (10.55 per cent) and Ludhiana (10.23 per cent) districts respectively.

Purposes of Loans

The purpose-wise distribution of debt is shown in Table 4. The table elucidates that the sampled women labour households, on an average, are spending the maximum proportion of loans for productive purposes in all the districts under study. This proportion is the highest, i.e., 67.70 per cent in Hoshiarpur district followed by Sangrur and Ludhiana districts with proportion of 55.41 per cent and 54.68 per cent respectively. It implies that 32.30 per cent, 44.59 per cent and 45.32 per cent of debt is spent on unproductive purposes in Hoshiarpur, Sangrur and Ludhiana districts respectively. Among the productive purposes, the major proportion of loans is spent on the repayment of old debt in Ludhiana (19.70 per cent) and Sangrur (17.61 per cent) districts. However, in Hoshiarpur district, the major proportion of loans is spent on the purchase of livestock (15.02 per cent). While in the case of non-productive purposes, the major proportion of debt is spent on marriages and other socio-religious ceremonies in all the sampled districts. In Ludhiana, Sangrur and Hoshiarpur districts, 40.38 per cent, 39.54 per cent and 29.28 per cent of the debt is used for this purpose respectively.

TABLE 4—DEBT INCURRED BY SAMPLED WOMEN LABOUR HOUSEHOLDS FOR DIFFERENT PURPOSES : DISTRICT-WISE

(Mean Values in Rs.)

Sl. No.	Purpose of loan	Amount of Debt		
		Sangrur district	Ludhiana district	Hoshiarpur district
A.	**Productive**			
1.	Redemption f old debt	4,361.03 (17.61)	5,663.47 (19.70)	2,819.07 (14.24)
2.	Purchase of livestock	2,953.74 (11.93)	2,296.45 (7.99)	2,972.89 (15.02)
3.	Expenditure on self-employment	1,957.15 (7.90)	3,383.73 (11.77)	2,328.63 (11.76)
4.	Education	477.85 (1.93)	324.99 (1.13)	920.37 (4.65)
5.	House construction and major repairs	1,189.50 (4.80)	1,414.56 (4.92)	1,871.47 (9.45)
6.	Healthcare	614.32 (2.49)	1,137.86 (3.96)	1,101.94 (5.57)
7.	Expenditure on non-durables	2,164.44 (8.75)	1,498.06 (5.21)	1.387.49 (7.01)
	Sub-total	**13,718.03 (55.41)**	**15,719.12 (54.68)**	**13,401.86 (67.70)**
B.	**Unproductive**			
1.	Marriage and other socio-religious ceremonies	9,789.58 (39.54)	11,609.07 (40.38)	5,797,32. (29.28)
2.	Intoxicants and drugs	820.33 (3.31)	1,171.85 (4.08)	302.62 (1.53)
3.	Miscellaneous	430.99 (1.74)	248.91 (0.86)	294.80 (1.49)
	Sub-total	**11,040.90 (44.59)**	**13,029.83 (45.32)**	**6,394.74 (32.30)**
	Total (A + B)	**24,758.93 (100.00)**	**28,748.95 (100.00)**	**19,796.60 (100.00)**

Source **:** Field Survey, 2010-11.
Note : The figures given in parentheses denote percentage

Rate of Interest

The data showing the debt according to rate of interest across the sampled districts is presented in Table 5. The table reveals that the sampled women labour households, on an average, in Hoshiarpur district have taken the maximum loans (29.82 per cent) at the rate of interest ranging from 6 to 12 per cent per annum. While in Ludhiana and Sangrur districts, the maximum loans, i.e., 25.94 per cent and 24.72 per cent respectively are taken at the rate of interest ranging from 24 to 30 per cent.

TABLE 5—DEBT ACCORDING TO RATE OF INTEREST : DISTRICT-WISE

(Mean Values in Rs.)

Rate of interest (Per cent per annum)	Amount of Debt		
	Sangrur district	Ludhiana district	Hoshiarpur district
Less than 6	329.65 (1.33)	450.46 (1.57)	508.53 (2.57)
6 to 12	3,416.96 (13.80)	4,257.15 (14.81)	5,902.83 (29.82)
12 to 18	0.00 (0.00)	0.00 (0.00)	729.23 (3.68)
18 to 24	3,343.06 (13.50)	2,395.00 (8.33)	3,078.30 (15.55)
24 to 30	6,119.68 (24.74)	7,456.16 (25.94)	4,115.94 (20.79)
30 to 36	5,073.99 (20.49)	6,244.15 (21.72)	2,783.60 (14.06)
36 to 42	3,704.61 (14.96)	4,203.68 (14.62)	1,829.67 (9.24)
42 to 48	2,129.13 (8.60)	3,269.18 (11.37)	634.57 (3.21)
48 and above	641.85 (2.60)	473.17 (1.64)	213.93 (1.08)
Total	**24,758.93 (100.00)**	**28,748.95 (100.00)**	**19,796.60 (100.00)**

Source **:** Field Survey, 2010-11.
Note : The figures given in parentheses denote percentage

It is deplorable to note that 75.29 per cent of loans are incurred by the sampled women labour households in Ludhiana district at more than 24 per cent rate of interest per annum. The corresponding proportions for Sangrur and Hoshiarpur districts are 71.37 per cent and 48.38 per cent respectively. This debt is mainly taken from the non-institutional sources.

Range of Debt

Table 6 exhibits the distribution of sampled women labour households according to the range of debt across the districts under study. The table clearly shows that the maximum number of indebted households fall in the range of Rs. 10,000 to Rs. 20,000. The proportion of sampled households in this range is the highest, 37.62 per cent in Hoshiarpur district and the lowest, i.e., 33.82 per cent in Ludhiana district. The corresponding proportion is 36.84 per cent in Sangrur district. As many as 25.79 per cent, 21.26 per cent and 17.82 per cent of the sampled households have debt ranging from Rs. 20,000 to Rs. 30,000 in Sangrur, Ludhiana and Hoshiarpur districts respectively. The households which have debt below Rs. 10,000 are 23.67 per cent in Ludhiana district, 22.77 per cent in Hoshiarpur district and 22.63 per cent in Sangrur district.

TABLE 6—DISTRIBUTION OF SAMPLED WOMEN LABOUR HOUSEHOLDS ACCORDING TO RANGE OF DEBT : DISTRICT-WISE

Range of Debt (in Rs.)	Sampled households		
	Sangrur district	Ludhiana district	Hoshiarpur district
No debt	7 (3.68)	9 (4.35)	12 (11.88)
Below 10,000	43 (22.63)	49 (23.67)	23 (22.77)
10,000–20,000	70 (36.84)	70 (33.82)	38 (37.62)
20,000–30,000	49 (25.79)	44 (21.26)	18 (17.82)
30,000–40,000	16 (8.42)	23 (11.11)	8 (7.93)
40,000–50,000	5 (2.64)	11 (5.31)	2 (1.98)
50,000 and above	0 (0.00)	1 (0.48)	0 (0.00)
Total	**190** **(100.00)**	**207** **(100.00)**	**101** **(100.00)**

Source : Field Survey, 2010-11.
Note : The figures given in parentheses indicate percentages

Further, under the debt range of Rs. 30,000 to Rs. 40,000, there are 11.11 per cent, 8.42 per cent and 7.93 per cent sampled households in Ludhiana, Sangrur and Hoshiarpur districts respectively. As many as 5.31 per cent sampled households in Ludhiana district, 2.64 per cent in Sangrur district and 1.98 per cent in Hoshiarpur district are under the debt range of Rs. 40,000 to Rs. 50,000. Moreover, there is only a single household (0.48 per cent) in Ludhiana district which has debt in the range of Rs. 50,000 and above. Only 11.88 per cent, 4.35 per cent and 3.68 per cent sampled households have no debt at all in Hoshiarpur, Ludhiana and Sangrur districts respectively.

Determinants of Indebtedness

In order to analyse the variations in the significance of factors influencing the magnitude of indebtedness, district-wise analysis has also been done and it has been reflected in Table 7.

TABLE 7—FACTORS AFFECTING INDEBTEDNESS AMONG SAMPLED WOMEN LABOUR HOUSEHOLDS : DISTRICT-WISE (RESULTS OF MULTIPLE REGRESSION ANALYSIS)

Sl. No.	Factors	Sangrur district	Ludhiana district	Hoshiarpur district
1.	Family-size	–0.3173	0.1526* (1.69)	0.2271* (2.86)
2.	Radio of credit from the non-institutional sources to that from the institutional sources	0.4266* (2.24)	0.3513* (1.78)	0.2235* (1.27)
3.	Number of females in the family	– 0.1854* (2.03)	– 0.2276	0.1183
4.	Expenditure on unproductive purposes	0.6841* (1.66)	0.5478* (1.74)	0.3169* (2.89)
5.	Educational level of the decision-maker in the family	– 0.1094	– 0.1296	– 0.3536* (2.28)
6.	Ratio of the earning of female labourers to male counterpart in the family	– 1.0696* (2.36)	– 0.8266* (2.47)	– 0.5928* (2.89)
7.	Total household Income	– 0.5625* (2.27)	– 0.6255* (1.77)	– 0.7625* (2.92)
8.	Total household expenditure	0.3124* (1.58)	0.1931* (2.22)	0.2839* (1.37)
9.	Value of total household assets	0.1037* (2.16)	0.1132* (1.69)	0.0854* (2.41)
	R2	**0.71**	**0.68**	**0.73**

Source : Field Survey,2010-11.
Note : The Figures given in parentheses indicate t-values.
*Significant at five per cent.

Sangrur District

Variations in the magnitude of indebtedness among the sampled women labour households in Sangrur district are significantly explained by the ratio of the earning of female labourers to male counterpart, expenditure on unproductive purposes, total household income, and ratio of credit from non-institutional sources to that from institutional sources.

The negative sign of regression coefficients of the factors such as family-size, number of females in a family, educational level of the decision-maker in the family, ratio of the earning of female labourers to male counterpart in the family and total household income indicates that these factors have a negative relationship with indebtedness.

The other factors such as ratio of credit from non-institutional sources to that from institutional sources, expenditure on unproductive purposes, total household expenditure and value of total household assets have positive relationship with indebtedness. The coefficients of family-size and educational level of the decision-maker in the family are non-significant. All the other factors are statistically significant at five per cent level of probability. The coefficient of multiple determinations explains 71 per cent variations in magnitude of indebtedness in Sangrur district.

Ludhiana District

The estimates of regression coefficients suggest that the variations in the magnitude of indebtedness among the sampled women labour households in Ludhiana district are significantly explained by the ratio of the earning of female labourers to male counterpart in the family, expenditure on unproductive purposes, total household income and ratio of credit from non-institutional sources to that from institutional sources.

The regression coefficients for family-size, ratio of credit from non-institutional sources to that from institutional sources, expenditure on unproductive purposes, total household expenditure and value of total household assets are positive and statistically significant at five per cent level indicating a positive relationship with indebtedness.

The factors such as ratio of the earning of female labourers to male counterpart in the family and total household income contribute in decreasing indebtedness and the regression coefficients of these factors are statistically significant at five per cent level. The coefficients for the factors, viz. educational level of the decision-maker in the family and number of females in the family are negative but non-significant indicating a negative relationship with indebtedness. The coefficient of multiple determinations explains 68 per cent variations in magnitude of indebtedness in Ludhiana district.

Hoshiarpur District

The contribution of the explanatory variables such as total household income, the ratio of the earning of female labourers to male counterpart in the family, educational level of the decision-maker in the family and expenditure on unproductive purposes are statistically significant in the case of Hoshiarpur district.

The explanatory variables, i.e., family-size, ratio of credit from non-institutional sources to that from institutional sources, expenditure on unproductive purposes, total household expenditure and value of total household assets have a positive and statistically significant relationship with indebtedness. The coefficient for number of females in the family is found to be positive and statistically non-significant.

Educational level of the decision-maker in the family, ratio of the earning of female labourers to male counterpart in the family and total household income have significant contribution towards decreasing the magnitude of indebtedness among the sampled households in Hoshiarpur district. The coefficient of multiple determinations explains 73 per cent variations in magnitude of indebtedness in Hoshiarpur district.

Conclusion and Policy Implications

1. A large majority of the sampled women labour households are under debt in the rural areas of Punjab. The indebted sampled women labour households range from 88.12 per cent in Hoshiarpur district to 96.32 per cent in Sangrur district. The corresponding proportion in Ludhiana district is 95.65 per cent.

2. The sampled women labour households, on an average, in Ludhiana district take 85.21 per cent of the loans from the non-institutional sources, while the corresponding figures for Sangrur and Hoshiarpur districts are 82.65 per cent 70.81 per cent respectively. Larger farmers and landlords appear to be the largest contributor towards loans in all the three sampled districts.

3. It is pertinent to note that the sampled women labour households, on an average, are spending the maximum proportion of loans for productive purposes in all the districts under study.

4. It is deplorable to note that 75.29 per cent of loans are incurred by the sampled women labour households in Ludhiana district at more than 24 per cent rate of interest per annum. The corresponding proportions for Sangrur and Hoshiarpur districts are 71.37 per cent and 48.38 per cent respectively.

5. It has been found that the factors such as educational level of the decision-maker in the family, ratio of the earning of female labourers to male counterpart in the family and total household income have a negative regression coefficient which indicates that these factors have a negative relationship with indebtedness

in all the three sampled districts. On other hand, the factors such as ratio of credit from non-institutional sources to that from institutional sources, expenditure on unproductive purposes, total household expenditure and value of total household assets have a positive relationship with indebtedness in all the districts under study. The regression coefficient of the factor, viz. family-size is found to be negative in Sangrur district which indicates a negative relationship with indebtedness. However, this factor has appeared with positive values in Ludhiana and Hoshiarpur districts. Another factor, i.e., number of females in the family is found to be positive in Hoshiarpur district. However, this factor has a negative relationship with indebtedness in Sangrur and Ludhiana districts.

The above analysis indicates that a large majority of the women labour households are under debt in the rural areas of Punjab. To improve their economic condition and overcome their problem of debt, effective measures should be taken by the government and non-government organizations. To overcome the problem of non-availability of required amount of credit at proper time and reasonable rate of interest, the government must exercise a strong check on the activities of non-institutional credit sources and provide institutional credit facilities to the women labour households at low rate of interest with easy repayment facilities. To raise the income levels of the women labour households, the central and state governments must take strong initiatives for creating sufficient employment opportunities and should effectively implement the policies for the women labour households. To reduce the seasonal unemployment, the government should effectively implement employment-oriented programmes especially during the off-season. For this purpose, the agro-based small-scale industries should be established in the rural areas on priority basis. There is an urgent need to create awareness among the women labourers about various employment programmes meant for them. Apart from it, quality education should be provided to the children of the labourers so that they may get jobs in the non-agriculture sector also which may ultimately lead to improve the economic condition of their families. Women labour households should be educated about the benefits of a small family through media. To reduce unproductive expenditure, a mass campaign should be launched by the government and non-government organisations against the use of intoxicants/drugs in the rural areas. This may help to solve many problems of the women labour households. The women labour households also need to be educated to manage their living and consumption expenditure within their means.

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AGRICULTURAL PRICES IN INDIA

It is an old adage that Agricultural prices mirror the economy of a country. It is more true in the case of an agricultural country like India. Viewed from this angle, it is quite an important publication. It gives information on index numbers, farm (Harvest) prices, wholesale and retail prices of various agricultural commodities, etc.

Climate Change and Agriculture-Interface issues, effects & policy implications-Cross Country Review

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The effects of climate change on agriculture are being witnessed all over the world. Small and marginalize farmers with poor coping mechanisms are more vulnerable in view of their dependence on agriculture and excessive pressure on natural resources. In the recent years, there has been significant rise in the frequency of extreme weather events affecting form level productivity and impacting availability of staple food grains since climate change poses complex challenges like multiple a bio-tic stresses on cops and livestock, shortage of water land degradation and loss of biodiversity, focused and long termed research is required to find solutions to the problems. This paper reviews recent literature concerning a wide range of processes through which climate change could potentially impact global-scale agricultural productivity, and presents projections of changes in relevant meteorological, hydrological and plant physiological quantities from a climate model ensemble to illustrate key areas of uncertainty. Few global-scale assessments have been carried out, and these are limited in their ability to capture the uncertainty in climate projections, and omit potentially important aspects such as extreme events and changes in pests and diseases. There is a lack of clarity on how climate change impacts on drought are best quantified from an agricultural perspective, with different metrics giving very different impressions of future risk. The dependence of some regional agriculture on remote rainfall, snowmelt and glaciers adds to the complexity. Indirect impacts via sea-level rise, storms and diseases have not been quantified. Perhaps most seriously, there is high uncertainty in the extent to which the direct effects of CO_2 rise on plant physiology will interact with climate change in affecting productivity. At present, the aggregate impacts of climate change on global-scale agricultural productivity cannot be reliably quantified. Climate change occurs over decades or longer time-scales. Until now, changes in the global climate have occurred naturally, across centuries or millennia, because of continental drift, various astronomical cycles, variations in solar energy output and volcanic activity. Over the past few decades it has become increasingly apparent that human actions are changing atmospheric composition, thereby causing global climate change.

1.1 Introduction

Climate change is a reality and the main cause of the present situation is on account of the anthropogenic activities disturbing the composition of the atmosphere resulting in higher concentration of Carbon Dioxide (CO2) which accumulates along with other green house gases (GHG) like methane and nitrous oxide and contribute to increase in surface temperature of the earth. The main contributors have been the developed countries like US and EU but now other developing countries like China are slowly replacing as the main polluters. However, the per capita emission reveals that the main emitters are the developed countries. If the pace of this emission moves then it is expected the CO2 concentration which is currently less than 400 parts per million might shoot above 800 if high emission continues by the end of this century.

As the scientific consensus grows that significant climate change, in particular increased temperatures and precipitation, is very likely to occur over the 21st century (Christensen and Hewitson, 2007), economic research has attempted to quantify the possible impacts of climate change on society. Since climate is a direct input into the agricultural production process, the agricultural sector has been a natural focus for research. The focus of most previous empirical studies has been on the US, but vulnerability to climate change may be greater in the developing world, where agriculture typically plays a larger economic role. Credible estimates of the impact of climate change on developing countries, then, are valuable in understanding the distributional effects of climate change as well as the potential benefits of policies to reduce its magnitude or promote adaptation. This paper provides evidence on the impact of climate change on agriculture in India, where poverty and agriculture are both salient, find that climate change is likely to reduce agricultural yields significantly and that this damage could be severe unless adaptation to higher temperatures is rapid and complete. Most previous studies of the economic effects of climate change have followed one of two methodologies, commonly known as the production function approach and the Ricardian approach. The production function approach (also known as crop modelling) is based on controlled agricultural experiments, where specific crops are exposed to varying climates in laboratory-type settings

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such as greenhouses, and yields are then compared across climates. This approach has the advantage of careful control and randomized application of environmental conditions. However, these laboratory-style outcomes may not reflect the adaptive behaviour of optimizing farmers. Some adaptation is modelled, but how well this will correspond to actual farmer behaviour is unclear. If farmer's actual practices are more adaptive, the production function approach is likely to produce estimates with a negative bias. On the other hand, if the presumed adaptation overlooks constraints on farmers. Adaptations or does not take adjustment costs into account, these estimates could be overoptimistic. The Ricardian approach, pioneered by Mendelssohn et al. (1994), attempts to allow for the full range of compensatory or mitigating behaviours by performing cross-sectional regressions of land prices on county-level climate variables, plus other controls. If markets are functioning well, land prices will reflect the expected present discounted value of profits from all, fully adapted uses of land, so, in principle, this approach can account for both the direct impact of climate on specific crops as well farmers adjustment of production techniques, substitutions of different crops and even exit from agriculture. However, the success of the Ricardian approach depends on being able to account fully for all factors correlated with climate and influencing agricultural productivity. Omitted variables, such as unobservable farmer or soil quality, could lead to bias of unknown sign and magnitude.

The paper finds significant light on impacts, with medium-term (2010-2039) climate change predicted to reduce yields by 4.5 to nine percent, depending on the magnitude and distribution of warming. The impact of long-run climate change (2070-2099) is even more detrimental, with predicted yields falling by 25 percent or more. Because these large changes in long-run temperatures will develop over many decades, farmers will have time to adapt their practices to the new climate, likely lessening the negative impact. However, estimates from this panel data approach may be more relevant for the medium-run scenario, since, as the paper's theoretical section argues, developing country farmers face significant barriers to adaptation, which may prevent rapid and complete adaptation. The impact of climate change on agriculture is likely to have a serious impact on poverty: recent estimates from across developing countries suggest that one percentage point of agricultural GDP growth increases the consumption of the three poorest deciles by four to six percentage points (Ligon and Sadoulet, 2007). The implication is that climate change could significantly slow the pace of poverty reduction in India.

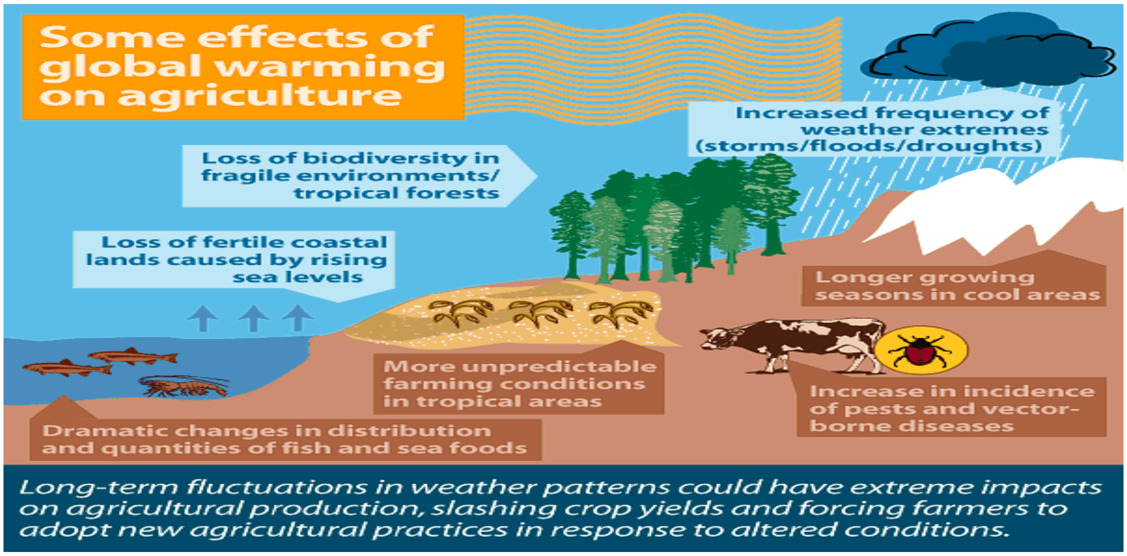
1.2 Issues

Climate change and agriculture are interrelated processes, both of which take place on a global scale. Global warming is projected to have significant impacts on conditions affecting agriculture, including temperature, carbon dioxide, glacial run-off, precipitation and the interaction of these elements. These conditions determine the carrying capacity of the biosphere to produce enough food for the human population and domesticated animals. The overall effect of climate change on agriculture will depend on the balance of these effects. Assessment of the effects of global climate changes on agriculture might help to properly anticipate and adapt farming to maximize agricultural production. At the same time, agriculture has been shown to produce significant effects on climate change, primarily through the production and release of greenhouse gases such as carbon dioxide, methane, and nitrous oxide, but also by altering the Earth's land cover, which can change its ability to absorb or reflect heat and light, thus contributing to radioactive forcing. Land use change such as deforestation and desertification, together with use of fossil fuels, are the major anthropogenic sources of carbon dioxide; agriculture itself is the major contributor to increasing methane and nitrous oxide concentrations in Earth's atmosphere. Increasing population and rising economic growth are putting tremendous pressure on the agriculture sectors to meet the present and future demand for food commodities. Unfortunately, the agriculture sector is confronted with numerous inherited challenges, which include stagnating crop yields and decline profitability mainly due to growing input use inefficient and deteriorating quality & quantity of natural resources. Rising food prices, inconsistent trade policies and deteriorating agro-institution are further aggravating the agrarian crisis. Climate change is further exasperating the agricultural sector. Evidences show that agriculture sectors are more vulnerable to climate change as their risk bearing ability is extremely low. It is, therefore, important to minimize climate impact through available adaptation options. There is a need to develop in inventory of climate smart agriculture options and assess their technical and financial feasibility at different scales. Since, resources are limited and agro-ecologies and socio-economic conditions are heterogeneous, it is also necessary to prioritize adaptation intervention for higher impacts. The focus needs to pro-poor and risk mitigation options for different agro-ecological and socio-economic environments. Climate change has emerged as daunting challenge fir the global community. Agriculture sector has been impacted with production declining due to climate change effects such as heavy rainfall, drought, flood and landslides. This has further aggravated problem for hunger. We have faced these problems repeatedly in developing countries. We can never be prosperous without eradicating food crisis, poverty, malnutrition and ultimate address the impact on climate changes. Developed countries must extend their role for their financial and other assistance can go on long ways in helping fight against poverty, food crisis, hunger, climate change and malnutrition. Rich industrialized countries are more responsible for emission of greenhouse gases. But environmental degradation and climate change have adversely impact countries like third world. Furthermore, developing countries are more affected due to lack of investment and technical capacity to cope with impacts. Glaciers are at risk. As climate change has adversely impacted agriculture, biodiversity, water resources, health, and forestry sectors, employment and livelihood of indigenous people and marginalized communities living in such areas is also at great risk. They are not responsible for this and should not be blamed. But they have to pay in terms of the impacts they have to bear. In this sense, they are heavily penalized. Environmental problems and challenges can be grouped in two categories: natural and man-made. As majority of the problem are related to deforestation, it is necessary to emphasize forest management. Should focused that location-specific and climatic appropriate tree species should be planted and natural for positive impact on the environment to ensure the conservation of species, and as sinks for greenhouse gases so as to increase possibilities of carbon trade, Such as plantation should pay attention to economic benefits and social usefulness. Climate change is looming large on the globe and has become a major issue of our concern. This situation of the global environment poses threat at several fronts. Agriculture which is closely linked with weather cycle is one of such fronts. All agricultural operations are designed in tune with climate pattern. Even a slight fluctuation in any critical environmental factor such as temperature may cause irreversible damage to agricultural performance. The present book underlines such concerns about current status our environment and agriculture. Edited by prominent scholars of the first and the largest agricultural university of India the book collates the perspective and research based articles portraying agriculture scenarios under the spell of on going climate change and offering adaptation strategies to overcome current and perceived problems. Containing 20 chapters the book discusses impact of the changing climate on agriculture and of agriculture on environment climate change influence on productivity of crops effect of high diurnal temperature on pollen and spike let sterility climate change effects on forests and forestry and livestock livestock's contribution to global warming etc. The book also attempts to underline various strategies for reducing agricultures vulnerability to climate change and for adaptation to on going climate change. The book will be useful for agriculturist's climate change specialist's environmentalist's policy makers and research scholars engaged in research on climate agriculture related issues. Weather is the continuously changing condition of the atmosphere, usually considered on a time scale that extends from minutes to weeks. Climate is the average state of the lower atmosphere, and the associated characteristics of the underlying land or water, in a particular region, usually spanning at least several years. Climate variability is the variation around the average climate, including seasonal variations and large-scale regional cycles in atmospheric and ocean circulations such as the El Niño/ Southern Oscillation (ENSO) or the North Atlantic Oscillation.

1.3 The Climate System

Earth's climate is determined by complex interactions between the Sun, oceans, atmosphere, cry sphere, land surface and biosphere. The Sun is the principal driving force for weather and climate. The uneven heating of Earth's surface (being greater nearer the equator) causes great convection flows in both the atmosphere and oceans, and is thus a major cause of winds and ocean currents. Five concentric layers of atmosphere surround this planet. The lowest layer (troposphere) extends from ground level to around 10-12 km altitude on average. The weather that affects Earth's surface develops within the troposphere.

The next major layer (stratosphere) extends to about 50 km above the surface. The ozone within the stratosphere absorbs most of the sun's higher-energy ultraviolet rays. Above the stratosphere are three more layers: mesosphere, thermosphere and exosphere. Overall, these five layers of the atmosphere approximately halve the amount of incoming solar radiation that reaches Earth's surface. In particular, certain "greenhouse" gases, present at trace concentrations in the troposphere (and including water vapour, carbon dioxide, nitrous oxide, methane, halocarbons, and ozone), absorb about 17% of the solar energy passing through it. Of the solar energy that reaches Earth's surface, much is absorbed and reradiated as long-wave (infrared) radiation. Some of this outgoing infrared radiation is absorbed by greenhouse gases in the lower atmosphere, which causes further warming of Earth's surface. This raises Earth's temperature by 33ºC to its present surface average of 15ºC. This supplementary warming process is called "the greenhouses"



This diagram illustrates some of the effects global warming will have on agriculture.

There is much evidence to suggest that global warming would not adversely affect agricultural productivity in the United States; our country has the financial resources to invest in research programs and technologies that could help its producers adapt to changes. Genetic engineering, for example, could be used to develop crops that would flourish in any climate. Even poorer farmers could adjust planting dates, crop varieties, and use more chemicals. However, those with the least resources are the most vulnerable to the effects of global climate change; unfortunately, they are also the most likely to be adversely affected by population growth, resource depletion and other forms of environmental degradation. Farmers of developing nations, subject to the above conditions, would never be able to compete in the global market in the face of agricultural subsidies given to their counterparts in industrialized nations. (Johnson 1991).Despite technological advances, such as improved varieties, genetically modified organisms, and irrigation systems, weather is still a key factor in agricultural productivity, as well as soil properties and natural communities. The effect of climate on agriculture is related to variability in local climates rather than in global climate patterns. The Earth's average surface temperature has increased by 1.5°F {0.83°C} since 1880. Consequently, agronomists consider any assessment has to be individually considering each local area. On the other hand, agricultural trade has grown in recent years, and now provides significant amounts of food, on a national level to major importing countries, as well as comfortable income to exporting ones. The international aspect of trade and security in terms of food implies the need to also consider the effects of climate change on a global scale.

1.3.1 Effects of Climate change on Agriculture

Research studies states that, due to climate change, "southern Africa could lose more than 30% of its main crop, maize, by 2030. In South Asia losses of many regional staples, such as rice, millet and maize could top 10%".The Intergovernmental Panel on Climate Change (IPCC) has produced several reports that have assessed the scientific literature on climate change. The IPCC Third Assessment Report, published in 2001, concluded that the poorest countries would be hardest hit, with reductions in crop yields in most tropical and sub-tropical regions due In Africa and Latin America many rain fed crops are near their maximum temperature tolerance, so that yields are likely to fall sharply for even small climate changes; falls in agricultural productivity of up to 30% over the 21st century are projected. Marine life and the fishing industry will also be severely affected in some places. Below table exhibited food shortage due to climate change around the world to decreased water availability, and new or changed insect pest incidence.

TABLE 1—Food Shortage Around the World due to Climate Change

Countries	Per centage
1. South Asia	35
2. Sub-Sahara Africa	27
3. East Asia	19
4. South America and Carribean	7
5. West Asia and North Africa	6
6. Developed Countries	3
7. Caucasian and Central Asia	2
8. Australia and Oceania	1

The nature of agriculture and farming practices in any particular location are strongly influenced by the long-term mean climate state—the experience and infrastructure of local farming communities are generally appropriate to particular types of farming and to a particular group of crops which are known to be productive under the current climate. Changes in the mean climate away from current states may require adjustments to current practices in order to maintain productivity, and in some cases the optimum type of farming may change

In the short run the climate change could affect Indian agriculture as follows

*Increase in co_2 to 550 ppm increases of rice, wheat, legumes and oil seeds by 10to 20%. 1^{o}c increase in temperature may reduce yield of wheat, soybean, mustard, groundnut and potato by 3.7%, much higher losses at higher temperature

*Significant impact on food quality-basmati rice, wheat etc..Possibly some improvement in yield oc chickpea, rabi maize ,sorghum and millets and coconut in west coast/

Less loss in potato, mustard and vegetable in north westran india due to reduced frost damage.

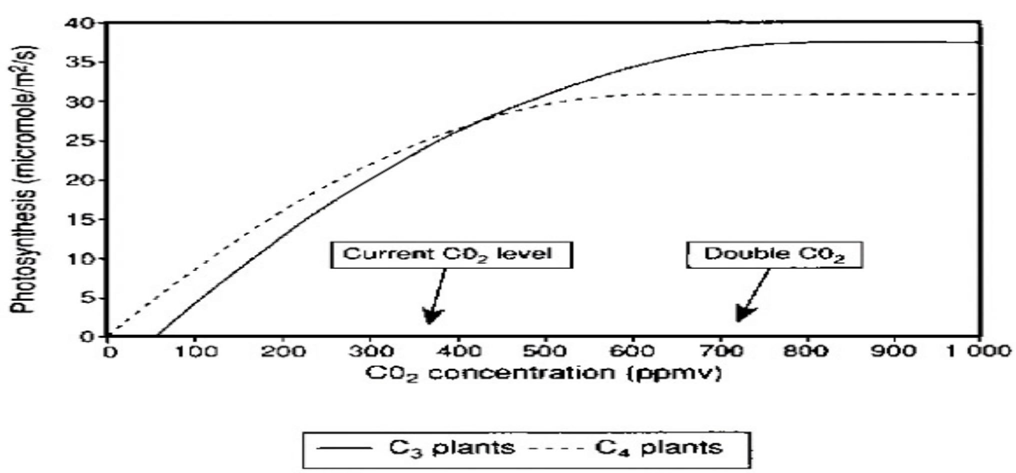
Productivity of most crops to decrease marginally by 2020 but by 10-40% by 2010

In the long run, the climatic change could affect agriculture in several ways :

- productivity, in terms of quantity and quality of crops
- agricultural practices, through changes of water use and agricultural inputs such as herbicides, insecticides and fertilizers
- environmental effects, in particular in relation of frequency and intensity of soil drainage (leading to nitrogen leaching), soil erosion, reduction of crop diversity
- Rural space, through the loss and gain of cultivated lands, land speculation, land renunciation, and hydraulic amenities.
- Adaptation, organisms may become more or less competitive, as well as humans may develop urgency to develop more competitive organisms, such as flood resistant or salt resistant varieties of rice.

They are large uncertainties to uncover, particularly because there is lack of information on many specific local regions, and include the uncertainties on magnitude of climate change, the effects of technological changes on productivity, global food demands, and the numerous possibilities of adaptation.

Most agronomists believe that agricultural production will be mostly affected by the severity and pace of climate change, not so much by gradual trends in climate. If change is gradual, there may be enough time for biota adjustment. Rapid climate change, however, could harm agriculture in many countries, especially those that are already suffering from rather poor soil and climate conditions, because there is less time for optimum natural selection and adoption.



The advent of global warming will have major effects on future agricultural productivity. As production increases to accommodate a growing population, so do emissions of the greenhouse gases carbon dioxide, methane, and nitrous oxide, further is exacerbating warming. Global warming will manifest itself in numerous ways and probably have a more dramatic affect on regional rather than global crop yields.

Rising temperatures and changing rainfall patterns will affect the kinds of crops that can grow in a particular place. Some areas, such as coastal regions, will no longer be suited for agriculture due to salt-water intrusion into freshwater aquifers (preventing irrigation) or flooding of prime agricultural land. However, other regions may experience a growth in productivity due to global warming; such regions may see a longer growing season, and rising levels of carbon dioxide tend to increase the efficiency of photosynthesis, thus accelerating plant growth. Wheat, rice and soybeans are especially responsive to higher levels of CO_2, characterized by C_3 pathways in the course of photosynthesis While C_3 plants will show increased productivity in correlation with initial increases in CO_2, over time, productivity will level off even as CO_2 continues to increase.

1.4 GLOBAL OBSERVATION

Observed impacts

So far, the effects of regional climate change on agriculture have been relatively limited. Changes in crop phonology provide important evidence of the response to recent regional climate change. Phonology is the study of natural phenomena that recur periodically, and how these phenomena relate to climate and seasonal changes. A significant advance in phonology has been observed for agriculture and forestry in large parts of the Northern Hemisphere.

Projections

As part of the IPCC's Fourth Assessment Report, Schneider et al. (2007) projected the potential future effects of climate change on agriculture. With low to medium confidence, they concluded that for about a 1 to 3 °C global mean temperature increase (by 2100, relative to the 1990–2000 average level) there would be productivity decreases for some cereals in low latitudes, and productivity increases in high latitudes. In the IPCC Fourth Assessment Report, "low confidence" means that a particular finding has about a 2 out of 10 chance of being correct, based on expert judgment. "Medium confidence" has about a 5 out of 10 chance of being correct. Over the same time period, with medium confidence, global production potential was projected to:

- Increase up to around 3 °C,
- Very likely decrease above about 3 °C.

Most of the studies on global agriculture assessed by Schneider et al. (2007) had not incorporated a number of critical factors, including changes in extreme events, or the spread of pests and diseases. Studies had also not considered the development of specific practices or technologies to aid adaptation.

The IPCC Fourth Assessment Report describes the impact of climate change on food security. Easter ling et al. (2007) looked at studies that made quantitative projections of climate change impacts on food security. It was noted that these projections were highly uncertain and had limitations. However, the assessed studies suggested a number of fairly robust findings. The first was that climate change would likely increase the number of people at risk of hunger compared with reference scenarios with no climate change. Projected climate change impacts depended strongly on future social and economic development. Additionally, the magnitude of climate change impacts was projected to be smaller compared to the impact of social and economic development. In 2006, the global estimate for the number of people undernourished was 820 million. Under the SRES A1, B1, and B2 scenarios projections for the year 2080 showed a reduction in the number of people undernourished of about 560–700 million people, with a global total of undernourished people of 100–240 million in 2080. By contrast, the SRES A2 scenario showed only a small decrease in the risk of hunger from the 2006 level. The smaller reduction under A2 was attributed to the higher projected future population level in this scenario.

1.5 Regional

- **Africa:**

  Africa's geography makes it particularly vulnerable to climate change, and seventy per cent of the populations rely on rain-fed agriculture for their livelihoods. Tanzania's official report on climate change suggests that the areas that usually get two rainfalls in the year will probably get more, and those that get only one rainy season will get far less. The net result is expected to be that 33% less maize—the country's staple crop—will be grown. Alongside other factors, regional climate change – in particular, reduced precipitation – is thought to have contributed to the conflict in Darfur. The combination of decade desertification and overpopulation are among the causes of the conflict, because the Baggara Arab nomads searching for water have to take their livestock further south, to land mainly occupied by farming peoples. With high confidence, IPCC (2007:13) concluded that climate variability and change would severely compromise agricultural production and access to food.

- **Asia:** With medium confidence, IPCC (2007:13) projected that by the mid-21st century, in East and Southeast Asia, crop yields could increase up to 20%, while in Central and South Asia, and yields could decrease by up to 30%. Taken together, the risk of hunger was projected to remain very high in several developing countries. More detailed analysis of rice yields by the International forecast 20% reduction in yields over the region per degree Celsius of temperature rise. Rice becomes sterile if exposed to temperatures above 35 degrees for more than one hour during flowering and consequently produces no grain.

- **Australia and New Zealand :** Hennessy et al.. (2007:509) assessed the literature for this region. They concluded that without further adaptation to climate change, projected impacts would likely be substantial: By 2030, production from agriculture and forestry was projected to decline over much of southern and eastern Australia, and over parts of eastern New Zealand; In New Zealand, initial benefits were projected close to major rivers and in western and southern areas. Hennessy et al.. (2007:509) placed high confidence in these projections.
- **Europe:** With high confidence, IPCC (2007:14) projected that in Southern Europe, climate change would reduce crop productivity. In Central and Eastern Europe, forest productivity was expected to decline. In Northern Europe, the initial effect of climate change was projected to increase crop yields.
- **Latin America:** With high confidence, IPCC (2007:14) projected that in drier areas of Latin America, productivity of some important crops would decrease and livestock productivity decline, with adverse consequences for food security. In temperate zones, soybean yields were projected to increase.
- **North America:**
- According to a paper by Deschenes and Greenstone (2006), predicted increases in temperature and precipitation will have virtually no effect on the most important crops in the US.
- With high confidence, IPCC (2007:14–15) projected that over the first few decades of this century, moderate climate change would increase aggregate yields of rain-fed agriculture by 5–20%, but with important variability among regions. Major challenges were projected for crops that are near the warm end of their suitable range or which depend on highly utilized water resources.
- **Small islands:** In a literature assessment, Mimura et al. (2007:689) concluded, with high confidence, that subsistence and commercial agriculture would very likely be adversely affected by climate change.

1.6 Finding

16.1 Shortage in grain production

Crops such as these sunflowers can be affected by severe drought conditions in Australia. Between 1996 and 2003, grain production has stabilized slightly over 1800 millions of tons. In 2000, 2001, 2002 and 2003, grain stocks have been dropping, resulting in a global grain harvest that was short of consumption by 93 millions of tons in 2003. The Earth’s average temperature has been rising since the late 1970s, with nine of the 10 warmest years on record occurring since 1995. In 2002, India and the United States suffered sharp harvest reductions because of record temperatures and drought. In 2003 Europe suffered very low rainfall throughout spring and summer, and a record level of heat damaged most crops from the United Kingdom and France in the Western Europe through Ukraine in the East. Bread prices have been rising in several countries in the region.

1.6.2 Poverty impacts

Researchers at the Overseas Development Institute (ODI) have investigated the potential impacts climate change could have on agriculture, and how this would affect attempts at alleviating poverty in the developing world. They argued that the effects from moderate climate change are likely to be mixed for developing countries. However, the vulnerability of the poor in developing countries to short term impacts from climate change, notably the increased frequency and severity of adverse weather events is likely to have a negative impact. This, they say, should be taken into account when defining agricultural.

1.6.3 Mitigation and adaptation in developing countries

The Intergovernmental Panel on Climate Change (IPCC) has reported that agriculture is responsible for over a quarter of total global greenhouse gas emissions. Given that agriculture’s share in global gross domestic product (GDP) is about 4 per cent; these figures suggest that agriculture is highly Green House Gas intensive. Innovative agricultural practices and technologies can play a role in climate mitigation and adaptation. This adaptation and mitigation potential is nowhere more pronounced than in developing countries where agricultural productivity remains low; poverty, vulnerability and food insecurity remain high; and the direct effects of climate change are expected to be especially harsh. Creating the necessary agricultural technologies and harnessing them to enable developing countries to adapt their agricultural systems to changing climate will require innovations in policy and institutions as well. In this context, institutions and policies are important at multiple scales.

1.6.4 Temperature potential effect on growing period

Duration of crop growth cycles are above all, related to temperature. An increase in temperature will speed up development. In the case of an annual crop, the duration between sowing and harvesting will shorten (for example, the duration in order to harvest corn could shorten between one and four weeks). The shortening of such a cycle could have an adverse effect on productivity because senescence would occur sooner.

16.5 Effect of elevated carbon dioxide on crops

Carbon dioxide is essential to plant growth. Rising CO_2 concentration in the atmosphere can have both positive and negative consequences. Increased CO_2 is expected to have positive physiological effects by increasing the rate of photosynthesis. Currently, the amount of carbon dioxide in the atmosphere is 380 parts per million. In comparison, the amount of oxygen is 210,000 ppm. This means that often plants may be starved of carbon dioxide, due to the enzyme that fixes CO_2, rubisco also fixes oxygen in the process of photorespiration. The effects of an increase in carbon dioxide would be higher on C3 crops (such as wheat) than on C4 crops (such as maize), because the former is more susceptible to carbon dioxide shortage. Studies have shown that increased CO_2 leads to fewer stomata developing on plants which leads to reduced water usage Under optimum conditions of temperature and humidity, the yield increase could reach 36%, if the levels of carbon dioxide are doubled.[Further, few studies have looked at the impact of elevated carbon dioxide concentrations on whole farming systems. Most models study the relationship between CO_2 and productivity in isolation from other factors associated with climate change, such as an increased frequency of extreme weather events, seasonal shifts, and so on.

In 2005, the Royal Society in London concluded that the purported benefits of elevated carbon dioxide concentrations are "likely to be far lower than previously estimated" when factors such as increasing ground-level ozone are taken into account."

16.6 Effect on quality

According to the IPCC's TAR, "The importance of climate change impacts on grain and forage quality emerges from new research, for rice, the anylase content of the grain a major determinant of cooking quality is increased under elevated CO_2"(Conroy et al., 1994). Cooked rice grain from plants grown in high-CO_2 environments would be firmer than that from today's plants. However, concentrations of iron and zinc, which are important for human nutrition, would be lower (Seneweera and Conroy, 1997). Moreover, the protein content of the grain decreases under combined increases of temperature and CO_2 (Ziska et al., 1997). Studies using FACE have shown that increases in CO_2 lead to decreased concentrations of micronutrients in crop plants. This may have knock-on effects on other parts of ecosystems as herbivores will need to eat more food to gain the same amount of protein. Studies have shown that higher CO_2 levels lead to reduced plant uptake of nitrogen (and a smaller number showing the same for trace elements such as zinc) resulting in crops with lower nutritional value. This would primarily impact on populations in poorer countries less able to compensate by eating more food, more varied diets, or possibly taking supplements. Reduced nitrogen content in grazing plants has also been shown to reduce animal productivity in sheep, which depend on microbes in their gut to digest plants, which in turn depend on nitrogen intake.

16.7 Agricultural surfaces and climate changes

Climate change may increase the amount of arable land in high-latitude region by reduction of the amount of frozen lands. A 2005 study reports that temperature in Siberia has increased three degree Celsius in average since 1960 (much more than the rest of the world). However, reports about the impact of global warming on Russian agriculture indicate conflicting probable effects: while they expect a northward extension of farmable lands,[40] they also warn of possible productivity losses and increased risk of drought.

Sea levels are expected to get up to one meter higher by 2100, though this projection is disputed. A rise in the sea level would result in an agricultural land loss, in particular in areas such as South East Asia. Erosion, submergence of shorelines, salinity of the water table due to the increased sea levels, could mainly affect agriculture through inundation of low-lying lands.

Low lying areas such as Bangladesh, India and Vietnam will experience major loss of rice crop if sea levels are expected to rise by the end of the century. Vietnam for example relies heavily on its southern tip, where the Mekong Delta lies, for rice planting. Any rise in sea level of no more than a meter will drown several km. of rice paddies, rendering Vietnam incapable of producing its main staple and export of rice.

16.8 Erosion and fertility

The warmer atmospheric temperatures observed over the past decades are expected to lead to a more vigorous hydrological cycle, including more extreme rainfall events. Erosion and soil degradation is more likely to occur. Soil fertility would also be affected by global warming. However, because the ratio of carbon to nitrogen is a constant, a doubling of carbon is likely to imply a higher storage of nitrogen in soils as nitrates, thus providing higher fertilizing elements for plants, providing better yields. The average needs for nitrogen could decrease, and give the opportunity of changing often costly fertilization strategies.

Due to the extremes of climate that would result, the increase in precipitations would probably result in greater risks of erosion, whilst at the same time providing soil with better hydration, according to the intensity of the rain. The possible evolution of the organic matter in the soil is a highly contested issue: while the increase in the temperature would induce a greater rate in the production of minerals, lessening the soil organic matter content, the atmospheric CO_2 concentration would tend to increase it.

16.9 Potential effects of global climate change on pests, diseases and weeds

A very important point to consider is that weeds would undergo the same acceleration of cycle as cultivated crops, and would also benefit from carbonaceous fertilization. Since most weeds are C3 plants, they are likely to compete even more than now against C4 crops such as corn. However, on the other hand, some results make it possible to think that weed killers could gain in effectiveness with the temperature increase.

Global warming would cause an increase in rainfall in some areas, which would lead to an increase of atmospheric humidity and the duration of the wet seasons. Combined with higher temperatures, these could favour the development of fungal diseases. Similarly, because of higher temperatures and humidity, there could be an increased pressure from insects and disease vectors.

16.10 Glacier retreat and disappearance

The continued retreat of glaciers will have a number of different quantitative impacts. In areas that are heavily dependent on water runoff from glaciers that melt during the warmer summer months, a continuation of the current retreat will eventually deplete the glacial ice and substantially reduce or eliminate runoff. A reduction in runoff will affect the ability to irrigate crops and will reduce summer stream flows necessary to keep dams and reservoirs replenished.

Approximately 2.4 billion people live in the drainage basin of the Himalayan rivers. India, China, Pakistan, Afghanistan, Bangladesh, Nepal and Myanmar could experience floods followed by severe droughts in coming decades. In India alone, the Ganges provides water for drinking and farming for more than 500 million people. The west coast of North America, which gets much of its water from glaciers in mountain ranges such as the Rocky Mountains and Sierra Nevada, also would be affected. Ozone and UV-Some scientists think agriculture could be affected by any decrease in stratospheric ozone, which could increase biologically dangerous ultraviolet radiation B. Excess ultraviolet radiation B can directly affect plant physiology and cause massive amounts of mutations, and indirectly through changed pollinator behaviour, though such changes are simple to quantify. However, it has not yet been ascertained whether an increase in greenhouse gases would decrease stratospheric ozone levels. In addition, a possible effect of rising temperatures is significantly higher levels of ground-level ozone, which would substantially lower yields.

1.6.11 ENSO effects on agriculture

ENSO (El Niño Southern Oscillation) will affect monsoon patterns more intensely in the future as climate change warms up the ocean's water. Crops that lie on the equatorial belt or under the tropical Walker circulation, such as rice, will be affected by varying monsoon patterns and more unpredictable weather. Scheduled planting and harvesting based on weather patterns will become less effective. Areas such as Indonesia where the main crop consists of rice will be more vulnerable to the increased intensity of ENSO effects in the future of climate change. University of Washington professor, David Battisti, researched the effects of future ENSO patterns on the Indonesian rice agriculture using [IPCC]'s 2007 annual report[50] and 20 different logistical models mapping out climate factors such as wind pressure, sea-level, and humidity, and found that rice harvest will experience a decrease in yield. Bali and Java, which holds 55% of the rice yields in Indonesia, will be likely to experience 9–10% probably of delayed monsoon patterns, which prolongs the hungry season. Normal planting of rice crops begin in October and harvest by January. However, as climate change affects ENSO and consequently delays planting, harvesting will be late and in drier conditions, resulting in less potential yields.

The agricultural sector is a driving force in the gas emissions and land use effects thought to cause climate change. In addition to being a significant user of land and consumer of fossil fuel, agriculture contributes directly to greenhouse gas emissions through practices such as rice production and the raising of livestock according to the Intergovernmental Panel on Climate Change, the three main causes of the increase in greenhouse gases observed over the past 250 years have been fossil fuels, land use, and agriculture.

1.6.12 Land use

Agriculture contributes to greenhouse gas increases through land use in four main ways:

- CO_2 releases linked to deforestation
- Methane releases from rice cultivation
- Methane releases from enteric fermentation in cattle
- Nitrous oxide releases from fertilizer application

Together, these agricultural processes comprise 54% of methane emissions, roughly 80% of nitrous oxide emissions, and virtually all carbon dioxide emissions tied to land use. The planet's major changes to land cover since 1750 have resulted from deforestation in temperate regions: when forests and woodlands are cleared to make room for fields and pastures, the albedo of the affected area increases, which can result in either warming or cooling effects, depending on local conditions. Deforestation also affects regional carbon reuptake, which can result in increased concentrations of CO_2, the dominant greenhouse gas. Land-clearing methods such as slash and burn compound these effects by burning biomaterial, which directly releases greenhouse gases and particulate matter such as soot into the air.

1.6.13 Livestock

Livestock and livestock-related activities such as deforestation and increasingly fuel-intensive farming practices are responsible for over 18% of human-made greenhouse gas emissions, including:

- 9% of global carbon dioxide emissions
- 35–40% of global methane emissions (chiefly due to enteric fermentation and manure)
- 64% of global nitrous oxide emissions (chiefly due to fertilizer use.

Livestock activities also contribute disproportionately to land-use effects, since crops such as corn and alfalfa are cultivated in order to feed the animals.

Worldwide, livestock production occupies 70% of all land used for agriculture, or 30% of the land surface of the Earth. Coal-fired power generation is the largest single contributor to NSW greenhouse gas emissions, so reducing emissions from this sector is critical to achieving substantial cuts in emissions. Technological solutions to control emissions, particularly 'carbon capture and storage' have been proposed.

Agriculture contributes 12% of Australia's emissions, largely due to methane, from ruminant livestock digestion, and nitrous oxide from soils. Methane and nitrous oxide are powerful greenhouse gases, with global warming potential 23 and 296 times, respectively, greater than that of carbon dioxide (IPCC 2001). Emissions of methane and nitrous oxide represent inefficiency and loss of energy, and therefore reducing these emissions will result in more efficient use of resources. A number of strategies could reduce ruminant methane emissions and emissions from manure. Management of soils in cropping, pastoral and forest systems can reduce nitrous oxide emissions and enhance methane uptake.

Forestry offers potential mitigation through sequestration in growing forests and in wood products, and use of forest biomass for bio energy. There is potential for bio fuels to reduce emissions from the transport sector. The opportunities for mitigation of greenhouse gas emissions through actions in the primary industries sector are described in this section. Predicted climate change impacts on agriculture the predicted changes to agriculture vary greatly by region and crop. Findings for wheat and rice are reported here:

1.6.14 Predicted climate change impacts on Indian agriculture

The predicted changes to agriculture vary greatly by region and crop. Findings for wheat and rice are reported here :

- Climate change is also predicted to lead to boundary changes in areas suitable for growing certain crops. Reductions in yields as a result of climate change are predicted to be more pronounced for rain fed crops (as opposed to irrigated crops)and under limited water supply situations because there are no coping mechanisms for rainfall variability.
- The difference in yield is influenced by baseline climate. In sub tropical environments the decrease in potential wheat yields ranged from 1.5 to 5.8%, while in tropical areas the decrease was relatively higher, suggesting that warmer regions can expect g1.

6.15 Wheat Production

• The study found that increases in temperature (by about 2ºC) reduced potential grain yields in most places. Regions with higher potential productivity (such as northern India) were relatively less impacted by climate change than areas with lower potential productivity (the reduction in yields was much smaller);

• Climate change is also predicted to lead to boundary changes in areas suitable for growing certain crops.

• Reductions in yields as a result of climate change are predicted to be more pronounced for rain fed crops (as opposed to irrigated crops) and under limited water supply situations because there are no coping mechanisms for rainfall variability.

1.6.16 Rice Production

• Overall, temperature increases are predicted to reduce rice yields. An increase of 2-4ºC is predicted to result in a reduction in yields.

• Eastern regions are predicted to be most impacted by increased temperatures and decreased radiation, resulting in relatively fewer grains and shorter grain filling durations. • By contrast, potential reductions in yields due to increased temperatures in Northern India are predicted to be offset by higher radiation, lessening the impacts of climate change.

• Although additional CO2 can benefit crops, this effect was nullified by an increase of temperature with changes in crops, as well as the need to shift some regions to new crops and the associated skills training required.

• Water policy: Because impacts vary significantly according to whether crops are rain fed or irrigated, water policy will need to consider the implications for water demand of agricultural change due to climate change.

• Adaptive measures: Policy-makers will also need to consider adaptive measures to cope with changing agricultural patterns. Measures may include the introduction of the use of alternative crops, changes to cropping patterns, and promotion of water conservation and irrigation techniques. What are the policy implications of these predictions?

The policy implications for climate change impacts in agriculture are multi-disciplinary, and include possible adaptations to:

• Food security policy: to account for changing crop yields (increasing in some areas and decreasing in others) as well as shifting boundaries for crops, and the impact that this can have on food supply.

• Trade policy: changes in certain crops can affect imports/exports, depending on the crop (this is particularly relevant for cash crops such as chillies).

• Livelihoods: With agriculture contributing significantly to GNP, it is critical that policy addresses issues of loss of livelihood

1.6.17 Needs for further research

Due to the complex interaction of climate impacts, combined with varying irrigation techniques, regional factors, and differences in crops, the detailed impacts of these factors need to be investigated further. Specific recommendations for further research include :

- Precision in climate change prediction with higher resolution on spatial and temporal scales;
- Linking of predictions with agricultural production systems to suggest suitable options for sustaining agricultural production;
- Preparation of a database on climate Change impacts on agriculture;
- Evaluation of the impacts of climate change in selected locations; and• Development of models for pest

1.7 Some Policy Issues

It is clear that climate change presents a significant threat to the future of Indian agriculture. It is, however, important to keep this threat in perspective. While there are a few indications of climate change having affected horticulture and fisheries already, the general increase in gross production and the established potential for yield increases point to the fact that climate change is very much a problem of the future. The fact that much scope exists for improving agricultural yields and production even in the current situation is particularly important in the context of international climate negotiations. This is because some climate-change activists and policy specialists exaggerate the immediacy of the threat from climate change in order to achieve an early international climate agreement. An accurate assessment of the threat to agriculture is essential in order to evaluate the room for manoeuvre that India and other less-developed countries have in international climate negotiations. At the same time, an international agreement that limits temperature rise to 2°C is critical, as the adaptability of agriculture to climate change has definite limits and the damage to agricultural production increases with rising temperatures. As we have noted earlier, the effect of carbon fertilisation cannot be relied upon, and will be undone as concentrations reduce and temperatures increase, even if a 2°C agreement is reached.

The threat of climate change makes the case for the accelerated development of Indian agriculture even more urgent. One of the main points of consensus in the literature on climate vulnerability, which is otherwise marked by many divergent results, is that the poor are the most vulnerable to the effects of climate change. Worldwide, the ability to cope with disasters in various regions is closely correlated to the levels of human development of these regions. All-round development has become ever more urgent in the era of climate change.

One of the significant features of India's vulnerability to climate change arises from the dependence on agriculture of a significant section of the total population, entirely out of proportion to the contribution of agriculture to total national income. Lessening this over-dependence on agriculture and providing non-farm livelihoods to a sizeable fraction of the population is a task that is even more pressing in the era of climate change.

There are several measures to reduce the impact of current climate variability that can help deal with the impact of climate change in the future. Among these measures are the following : [59]

- Further development of agro-meteorology with particular attention to the delivery of information in timely, accessible and understandable form to the rural population.
- Increasing emphasis on a proper system of agricultural insurance, which deals with not only gross deficiency of rainfall but also takes into account changes in precipitation and temperature patterns, and pays particular attention to the form and outcomes of extreme weather and weather-related events. Such an insurance system needs

to be in large part in the public sector, and to be integrated into a larger framework of social protection.

- Building suitable infrastructure, such as coastal protection systems, communication and transport infrastructure, flood protection systems, and so on.
- Development of suitable public institutions to cope with extreme weather events and other shocks.

There are substantial gaps in our knowledge with respect to the impact of climate change. Of these, it is clear from the literature that, given the expertise and capabilities available in India, the purely scientific–agronomic knowledge gaps can be dealt with over time. There is, however, far greater uncertainty regarding the economic and social consequences of climate change. Given the uncertainties regarding future climate change, knowledge of how to cope with it has to evolve over time. Further, coping mechanisms will eventually require suitable institutional linkages between agricultural science, the state and public institutions, and the rural population engaged in agriculture. Thus, while climate change is not yet an immediate threat, it certainly calls for action at many levels.

Climate change adaptation requires enormous financial and other resources; the scale and scope of this requirement have proved to be difficult to quantify, and have been subjects of much uncertainty and debate. What is generally accepted is that the finances required are likely to be large. In a context that calls for a coherent strategy from the state, the withdrawal of public expenditure on agriculture is a very disturbing trend. It is particularly disturbing that state-run systems of agricultural extension in India have largely been undermined by the Government of India from the early 1990s, and that there have been persistent attempts to reorient the strategies and aims of the national agricultural research system. The "Second Green Revolution" is sought to be based on a model of private sector-driven research and extension, with knowledge transfers from the developed world being strongly restricted by strong intellectual property rights (IPR) restrictions.

The Government of India has pursued a two-track approach to climate change adaptation, including in agriculture. In international climate negotiations, it has repeatedly called for state-to-state transfers of adaptation funds from developed to less-developed nations, resisting attempts by the former to consider financial transfers through existing multilateral financial institutions or the private sector. On the domestic front, the Government has announced a Mission on Sustainable Agriculture as one of eight missions under the National Action Plan for Climate Change (NAPCC).

What is paradoxical is that a policy that appears to privilege the public sector is much less evident in domestic policy in agriculture, where in fact the public sector has been in retreat. In this light, the Government of India's emphasis on the need for financial transfers from developed countries for climate adaptation-related work suggests as much a reluctance towards committing domestic finance to this end, as it does a plea for equity in international climate policy.

In conclusion, we re-emphasise what must be one of the foremost social concerns in the study of the impact of climate change, that is, the impact of climate change on the poor of the world, especially the rural poor. Although climate change affects all humanity, it has a disproportionately great impact on the poor. The poor will bear the brunt of climate change, particularly in the less-developed countries, though they have contributed the least to the problem of greenhouse gas emissions. In closing, we can hardly over-emphasize the need to ensure that, in an unequal world, the main burden of dealing with climate change is not placed on the poor.

1.8 CONCLUSION

Increasing population and rising economic growth are putting tremendous pressure on the agriculture sectors to meet the present and future demand for food commodities. Unfortunately, the agriculture sector is confronted with numerous inherited challenges, which include stagnating crop yields and decline profitability mainly due to growing input use inefficient and deteriorating quality & quantity of natural resources. Rising food prices, inconsistent trade policies and deteriorating agro-institution are further aggravating the agrarian crisis. Climate change is further exasperating the agricultural sector. Evidences show that agriculture sectors are more vulnerable to climate change as their risk bearing ability is extremely low. It is, therefore, important to minimize climate impact through available adaptation options.

Climate change has emerged as daunting challenge for the global community. Agriculture sector has been impacted with production declining due to climate change effects such as heavy rainfall, drought, flood and landslides. This has further aggravated problem for hunger. We have faced these problems repeatedly in developing countries. We can never be prosperous without eradicating food crisis, poverty, malnutrition and ultimate address the impact on climate changes. Developed countries must extend their role for their financial and other assistance can go on long ways in helping fight against poverty, food crisis, hunger, climate change and malnutrition.

There is a need to develop in inventory of climate smart agriculture options and assess their technical and financial feasibility at different scales. Since, resources are limited and agro-ecologies and socio-economic conditions are heterogeneous, it is also necessary to prioritize adaptation intervention for higher impacts. The focus needs to pro-poor and risk mitigation options for different agro-ecological and socio-economic environments.

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Assessing the likely Consequences of Climate change on Rural Livelihood, Rice Production and Gender Roles in Rice Farming Communities in Assam, India

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Rice is the principal food crop of Assam and Northern-Eastern part of India. More than 90% population of the region depends on rice for the caloric requirement. Therefore, rice has been playing a key role in all spheres of life in the region. The total area under rice in is about 2.3 million hectares. Out of total area under rice, 0.2 M hectare is upland and same amount of area also under irrigated. The remaining rice areas which are about 1.9 million hectares are entirely rainfed and flood-prone. The average productivity of rice in the state is about 1.5 t/hectare which is way below the national average of 2.3 t/hectare. The climate of Assam is hot and humid which favor growth and development rice in rainy season.

Rice in Assam is grown mainly in three seasons, viz: Ahu (pre-rainy), Sali (rainy) and boro (post rainy). Sali rice occupy the highest acreage and mostly grown under rainfed condition in different submergence situations.

Perceptions on climate variability

Farming households are obviously realizing that temperature is rising gradually in recent years; extreme events such as unexpected incidence of flash floods, submergence, drought, incidence of pest and diseases have increased year by year in last decades. However, these climatic variables affecting crops, livestock and agroforestry etc. ultimately influence the livelihoods of farming households in stress-prone areas. The effect of climatic variation is more visible in severe stressed-prone areas where farmers are entirely dependent on rains. Flash floods and variable submergence regimes are the major constraints in increasing the productivity of rice in Assam where rice is cultivated in rainfed situation.

TABLE 1—Extent of Rice area Damaged and Yield Losses due to Flooding on Aggregate-level in Assam

Years	Yield (kg/ha)	Absolute damaged rice area (ha)	Share of total rice area (%)	Absolute production loss (ton)	Share of production loss (%)
2001-02	1540	28015	1	42023	1
2002-03	1491	571577	25	857366	28
2003-04	1555	381796	16	572694	19
2004-05	1476	997262	43	1495893	49
2005-06	1437	52461	2	78692	3
2006-07	1500	50000	22	75000	25
Average	1500	421852	18	632778	21

Source : Annual report 2009-10, RARS Titabar, AAU, Jorhat Assam India.

The nature of flood in Assam is very devastating during the rainy season. Table 1 indicates the scenario of devastating nature of flood in terms of damaged rice area and production in different years. Although, it is not an updated data, it indicates the extent of production loss. The severity of flood was extreme in 2004-05 and damaged 43 percent area (1 million ha) of total rice area and a substantial proportion (49 percent) of rice production was lost in the state. The range of rice area damaged due to different nature of flooding was low at 1 percent in 2001-02 and highest at 43 percent in 2004-05 of total rice area. Similarly the total production loss was also highest at 49 percent in the same year to total rice production in the State.

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A substantial rice area about 0.42 million was damaged due to floods in Assam accounted for 18 percent of total rice area in the State. Similarly, an average production loss of 0.63 million ton which is 21% to total rice production. The huge amount of production loss due to this abiotic stress is the matter of concern in every year. (Can cite which year or every year? What is the difference between the first and second statement first is the area of rice damaged and second related to production loss)?

In spite of a good rice improvement program and development of many new varieties in Assam in past several years rice productivity improvement in submergence-prone areas is a great challenge before breeder, administration, bureocrates and researchers. The average productivity of rice is 1.5 t/ha which is almost stable from past several years. The recently released MAS based Sub1 rice variety may be helpful in increasing rice productivity through hedgeing yield losses of submergence stress. Thus, intensive seed production and distribution of these varieties should make more efficient and instrumental.

Selection of Sites

The proposed study of climate variability, coping strategies and gender roles in Assam, all the sites of PVS experiments may be considered for detail study. Focus Group Discussions (FGDs) were conducted with groups of farmers along with the key-informants in four PVS experimental villages, two flood-prone districts of Assam during August 10-13, 2010. The scientists of Regional Agriculture Research Station, Titabar, AAU, and Agricultural Development Officers from Govt. of Assam and an IRRI social scientist organized the FGDs in which male and female farmers including de-facto and widows, landless laborers were participated. The details of districts, severe and less severely affected flood villages and number of male and female farmers are given in Table 2.

TABLE 2—DETAILS OF FOCUS GROUP DISCUSSION SITES

Districts	Villages	Extent of flooding	No. of male	No. of female	Total
Sibsagar	Joyarapar	Less severe	16	11	27
	Duwaragaon	Less severe	13	12	25
	Magarhat	Severe	17	13	30
Golaghat	Basabhalorua	Severe	18	14	32

The sites selected for implementation of the FGDs were the same where participatory varietal selection (PVS) trials of flood-tolerant rice varieties are being continued under the BMGF funded STRASA project. This was done to have a continuity in the work and provide additional support for women who are interested to be trained on production of quality rice seeds. Based on the experience of scientists working in those villages, the key informants were categorized in two groups based on extent of area and production damaged due to flood viz: severe and less severe villages. The less severe flood affected villages are Joyarapar and Duwargaon whereas Magarhat and Basabhalorua represent the more severe flood affecting villages. The number of farmers varied in each village but more than 25 farmers were included in the FGDs in all the sites. Therefore, a substantial number of farmers successfully participated in the discussion during the conduct of FGD in each sites. The selected villages are entirely rainfed with different nature of water stagnation in the rainy season with only one crop of rice grown during the year .

Extreme events

Table 3 indicates farmers' perceptions on the effects of deviation in different climatic variables which have negatively effects on their crop and livestock production since the last 10 years. Rising temperature was the most common climate variability identified by the farmers (Table 2) In case of frequency of floods and cyclones, Magarhat and Basabhalorua were severely affected, but the other two villages were free from these hazards.

Excessive flood related inundation is a common problem across the sites during kharif season in different stages of rice growth. The inundation problem was due to higher amounts of rains in very short time and usually starts from May-June just before transplanting of rice. This problem causes serious delay in planting of rice because farmers have to wait until the water in the fields are drained. Under this condition, rice seedlings become older (50-80 days after sowing in the seedbeds) and poorly performed due to their photosensitive nature which consequently led to poor yields.

TABLE 3—FARMERS' PERCEPTION OF EXTREME EVENTS

Extreme events/Villages	Joyarapar	Duwaragaon	Magarhat	Basabhalorua
Rising temperature	y	y	y	y
Increase in floods, cyclones	n	n	y	y
Excessive flood-related inundation	y	y	y	y
Shrinking cropping season	n	n	n	n
Temperature related yield loss	n	n	n	n
Unexpected incidence of drought	y	y	n	y
Unexpected incidence of flood	n	n	y	y

Notes : y = yes, n = no

Farmers also related their experience in relation to shrinking cropping season and yield loss due to rise in temperature. This rise in temperature can be easily observed on crops grown during the winter season. Due to the high temperature, wheat is not commonly grown in Assam.

Except Magarhut, the farmers from other sites perceive that drought is increasingly occurring in recent years during rice growth and mostly at the panicle initiation stage. Drought is becoming more unpredictable. The occurrence of extreme drought resulted to unfertile panicles or empty grains and thus reduced rice yields. During the discussions, the farmers in the severely affected flooded areas also mentioned the unexpected incidence of floods and submergence as the major problems.

Farmers perceived effect of area damage and yield loss:

Table 4 summarizes the effect of climate variability on different farming components, basic utilities, human and livestock health in different flood -prone sites in Assam. The average productivity of rice in normal flooding sites ranges from 2.0-2.2 t/ha. Whereas in the extremely flooding areas the average yield of rice was lower as about 1.5 t/ha. Thus the rice productivity differences in both the sites were clearly explained by the nature of flooding which has very common for those villages. There are other associated reasons as delayed planting, use of TVs, low fertilizer use etc. to lower productivity in PVS sites in addition to extreme flooding as stated by farmers.

A substantial amount of rice yield loss is the regular phenomenon due to flooding in rainfed low laying areas but the extent of yield losses were variable across the sites. In normal flooding areas about 10-60 percent yield was loss in every year. Similarly, 20-80 percent yield losses were occurred in another PVS site which has severely affected by the flood. The extent and frequencies of yield losses were more in later sites than the earlier. However, the yield losses occurred in two different ways: one is due to delayed planting of rice seedlings and another is longer standing water in the field. These reasons are very much common across the sites as revealed by the farmers during discussion.

TABLE 4—EXTENT OF DAMAGE

Items/Villages	Joyarapar	Duwaragaon	Magarhat	Basabhalorua
No. of participants	27	25	30	32
Rice yield (t/ha)	2.0	2.2	1.6	1.5
Yield loss due to flood (%)	30-40	10-60	20-60	25-80
Fisheries (reduced %)	not affected	40-60	30-40	30-40
Livestock (reduced %)	50-60	50-60	70-90	40-50
Human healh	affected	affected	affected	affected
Education of children	increased	inceased	affected	increased
Access to fuel wood	reduced (40-50%)	reduced	reduced (50-80%)	reduced
Access to drinking water	improved	improved	improved	improved
Access to animal fodder	reduced 60%	Reduced 40%	not affected	reduced 50%
Access to food	reduced nutritional food	increased	Effect can be managed	Reduced nutritional food
Others				

Livestock is an important source/component of livelihood of farming households in Assam, which is usually taken care by female farmers and children. But the number of livestock population has been declined very rapidly in recent years. As usual the declining rate of livestock population ranges from 40-60 percent in all sites except Magarhat where the corresponding range was 70-90 percent. This was mainly due to changing rainfall pattern, frequencies of floods and some time unexpected drought, unavailability of fodder, emergence of new diseases and migration of youths for better earnings from the stress-prone areas. Similarly the availability of local fish was also affected to a great extent due to aberrations of weather. The availability of livestock fodder was affected and reduced from 40-60% across the sites.

However, these weather aberrations not only affect crops, livestock and fisheries production but also serious problem for the human health. Therefore, a number of new diseases too emerging out but health care and consciousness also developed in the society. Expenses on medical and health care also increased in recent years.

In the rural area of Assam, non-farm income also gradually increased; therefore, parents are more serious to provide better education to their children. In some cases, even illiterate parents are interested in educating their son and daughter. The overall enrollment of students in the school and colleges increased drastically. In the years of extreme flooding, education of children may drop/or affected due to loss of crop in kharif as reported by female key-informants of Magarhat.

Of course, availability of fuel wood was reduced to the large extent due to deforestation of forest/grooves and depletion in the number of livestock. About 40-60 % of the fuel wood was reduced and in extreme cases the extent of reduction ranged from 50-80 percent. In earlier days women were responsible to collect fuel wood but they couldn't able to spare time due to pressure of house and farm related works. Availability of LPG and Kerosene oil in the market found useful to over come the problem of fuel in rural areas.

The problem of drinking water in rural areas of Assam has been solved through installation of shallow hand pump under special scheme as sponsored by Govt. of India. Food is available during normal flooding, whereas it is a problem of a substantial proportion of families during/ years of extreme flooding. Farmers also reported that they lack nutritious food unlike before when they have more small livestock and poultry.

Perceptions of climate variability and its effect on roles and responsibilities of :

Principal female (married) :

Due to rising temperature, females (married) no longer want to do field work. They prefer to stay at home and take care of their children's education (Golaghat).

Principal male :

The male farmers of the sites were responsible for plowing, transplanting, weeding and transporting bundles of rice from field to threshing floor, 10-15 years ago. Now they look for tractor for puddling and leveling. More women now are engaged in transplanting, weeding, harvesting and threshing. Male members look for non-farm opportunities in nearby villages for better wages.

Widows :

Five widows were supported in conduct of Focus Group Discussion along with other male and female farmers in Basabholurua, district Golaghat. They earlier worked on their own farm for rice cultivation but now they hire laborers due to poor health. Health deterioration may be due to strong sun light and high humidity which has occurred for 7-8 years. Laborers are also not willing to work in submerged rice field and high temperature and they have better opportunity to work in the urban areas in construction of building, road, shops and in self employment. Wage of farm laborer also increased more than twice due to MNREGA. Due to the rising wage costs, there is shortage of labor. It is difficult to get laborers at lower wages.

De facto female head :

The perception of de facto female who her self managing their farm in earlier by employing laborers found it hard to continue this practice. Reasons are very obvious that laborers do not want to work in rice field due to high temperature and muddy fields. They try to look for works which do not require exposure to hot weather. Thus, the migrant husband and son go back to their own farms during peak cropping season. The migrants also worked as exchange labor with their neighbors.

Adaptation practices of rice farming during floods:

Farmers of PVS sites adopt specific strategies like growing specific varieties- Ranjit, Bahdur, Mahsuri and Chakuabora (MVs) in normal date of planting and Prasad bhog, Soimari, Salipuna, Titafolia, Kalajoha, and Bordhan (TVs) if delayed. If rice damaged early in stage of planting due to severity of flood, replanting taking place may be up to 2nd week of August and increased number of plants per hill.

Survival Mechanisms during floods:

If the flooding occurs for longer periods and there is no way to save rice several mechanisms are employed by farmers such as mortgaging the land, disposal of assets including live stock, borrowing money from big farmers, money lenders, cooperative societies, friends and relatives. Moreover, adult members of family go to the urban areas for employment as laborer in construction work, serving on shops, rickshaw pulling etc . to support their families' livelihood.

C. Agro-Economic Research

Problems and prospects of Soyabean Cultivation in Maharashtra

I. Introduction

The technological breakthrough achieved in case of rice and wheat during the 1960s lead to remarkable increase in yield of these crops making the country self sufficient in foodgrains. From a food deficit and stagnant sector at the time of independence, the agricultural sector reached the stage of being a surplus food sector satisfying the domestic as well as foreign demand. With the success of these crops, the government started looking for such varieties of other crops also. Oilseeds was one such crop, demand for which outpaced the supply and India had to import edible oil (Chand, 2007).The technology mission on oilseeds (TMO) was launched in 1986 with the objective of increasing production of oilseeds. As a result of this, the oilseeds production increased gradually. It was observed that after the launch of TMO and during 1986-87 until 1996-97, oilseeds production performed much better than the cereals. The area under oilseeds grew rapidly. This particular phenomenon was called 'yellow revolution' wherein the crop pattern showed changes - area under coarse cereals got replaced by oilseeds and pulses (Gulati, 1999). Today India contributes around 8 percent to the world production of oilseeds (fao.org/fileadmin/templates/est/COMM_MARKETS_MONITORING/Oilcrops/Documents/Food_ outlook_ oilseeds/ Food_outlook_Nov _12.pdf).

Increasing area and production of the oil seeds indicates increasing importance of oilseeds i.e. the oils - in the consumption basket of the population. The NCAER elasticity estimates show that the per capita demand for edible oils would rise to 16 kg in 2014-15 (Damodaram and Hegde 2000). Consumption of edible oil in India has been growing faster than its production. It is observed that though net domestic availability has been increasing it has not been able to satisfy domestic demand and the year wise data on import shows that around 34 to 52 percent of the total availability is attributed to imports. The gap between demand and production of edible oil in India has increased sharply in recent years. Since 2000-01, production of oilseeds grew at the rate of 4.7 percent per annum, but edible oil consumption increased at the rate of 6.5 percent per annum (http://www.business-standard.com/article/press-releases/. February 20, 2013). Net domestic availability has increased in 2010-11 and has led to slight reduction in imports. However, due to increasing demand and consumption of edible oils, India still is the world's top vegetable oil importer. This certainly highlights the need to increase the oilseed production.

Our demand for edible oils is mainly satisfied by palm oil, soybean oil and mustard oil. As mentioned earlier, with the technological breakthrough in wheat, and rice attention was focused on other crops and soybean was one such oilseed crop. New varieties of soybean were introduced for commercial usage in India in 1970s. There was a marked increase in the area as well as production of this crop. Today soybean or the 'miracle bean'has come to occupy an important position as a global crop. The world area under cultivation of this crop is growing continuously. The world soybean production has increased two and half times from 24.7 million tonnes in 1981-82 to 220.81 million tonnes in 2007-08 (http://www.sopa.org/st8.htm). Its importance as an oilseed crop is revealed from its share in the total world oilseed production which was as high as 56 percent in 2011 (http://www.soystats.com/2012/Default-frames.htm). The major players in the world production viz. the U.S.A., Argentina, Brazil and China produce around 85 percent of the world soybean production. India occupies fifth position after China in this regard.

Groundnut, rapeseed-mustard and soybean are the major oilseeds that together contribute 80 percent to the area and 90 percent to the total oilseeds production in the Indian context. The share of soybean in area and production of major oilseeds increased very rapidly after it was introduced in 1970s. In 2010-11 around 35 percent of the area and 39 percent of the production of major 9 oilseeds at all India level was contributed by soybean. For the year 2011-12, the 4th advance estimate shows that the area under soybean was 10.18 million hectares and the production was 12.28 million tones. It is observed that area under this crop has been increasing continuously since 2001-02. Share of area under and production of groundnut is declining continuously whereas that of rapeseed and mustard is fluctuating and was around 25 percent in 2010-11.

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TABLE 1: SHARE OF MAJOR EDIBLE OILSEEDS IN AREA AND PRODUCTION OF TOTAL OILSEEDS IN INDIA

(In percent)

Year	1961		1971		1981		1991		2001		2010-11	
	A	P	A	P	A	P	A	P	A	P	A	P
Groundnut	46.91	68.91	44.05	63.45	38.64	53.47	34.41	40.35	28.81	34.76	21.53	25.43
Rapeseed Mustard	20.92	19.34	19.95	20.56	23.35	24.55	23.93	28.10	19.68	22.72	25.35	25.18
Soyabean	—	—	0.18	0.10	3.47	4.70	10.60	13.97	28.19	28.63	35.27	39.22
Sunflower	—	—	0.72	0.83	0.68	0.75	6.75	4.67	4.70	3.52	3.42	2.00
Total	67.83	88.25	64.90	84.94	66.14	83.46	75.69	87.10	81.38	89.64	85.56	91.84

Source : Gol, 2012

Madhya Pradesh and Maharashtra are the two major soybean producing states and currently contribute more than 80 percent to the total area and production of soybean in India. In the year 2010-11, Madhya Pradesh, the highest producing state contributed more than 50 percent to the total area under and production of soybean. It is followed by Maharashtra which occupies around one third area under soybean and contributes 33 percent to the total soybean production. It can be noted that the per hectare yield in case of Maharashtra is higher than that in Madhya Pradesh. Maharashtra being one of the major soybean producing states with higher productivity, this study attempts to analyse the status of soybean cultivation in Maharashtra and studies the problems and prospects of soybean cultivation in the state.

The state of Maharashtra is the second largest state in India in terms of area and population. It houses the financial capital of India i.e. Mumbai and contributes 14.4 percent to the gross domestic product (GDP).The per capita gross state domestic product (GSDP) at factor cost per annum in 2011-12 was Rs.l,05,623 and was higher than the per capita GDP at factor cost which was Rs. 69,497.The state has growing secondary and tertiary sectors which contribute almost 87.1 percent to the state income. Only around 12.9 percent of the state income is contributed by the agricultural sector. Inspite of its progress in the industrial sector, the state still can be called as an agrarian state as almost 57 percent of the state population is still dependent on this sector for its livelihood. It can be noted that the share of agricultural and allied activities in the GSDP has been declining continuously. However, there has been no commensurate decline in the labour force in agriculture as per Census as well as NSSO estimates.

The major constraining factor for this sector is the scanty rainfall in several parts of the state and the extent of irrigation which covers only 18 percent of the land under cultivation as against 44.5 percent at all India level. During 2009-10, average per hectare yield of food grains in the state was 1074 kg. which was far below the national average of 1798 kg per hectare. This explains the lower productivity of several crops grown in the state.

Around 54 percent of the area under cultivation is occupied by food grains as of now and gradually the cropping pattern is shifting towards commercial crops .The area under food crops has declined to 54 percent from 69 percent in TE 1973-74. This is mainly due to a decline in area under the staple cereals- jowar and bajra. Area under pulses (except gram) has almost remained stagnant. The crops that have recorded increase in area and production are the oilseed crops. These mainly include soybean along with sunflower. Area under crops like sugarcane, cotton, has also increased. Area under fruits and vegetables has recorded an impressive growth, though in absolute terms, area under these crops is less. The cropping pattern is thus gradually shifting towards non food crops. This indicates preference of the consumers for high value crops with gradually increasing incomes. The gross cropped area in the state has increased only marginally indicating limits to area expansion.

The growing importance of oilseed cultivation in Maharashtra's agriculture is clear from the increasing trend in area under oil seeds which was around 15 lakh ha in 1970- 71 and 36 lakh ha in 2010 -11 and which registered an increase of more than 140 percent. The share of oilseeds in the GCA which was around 8 percent in TE 1973-74, increased to 17 percent in TE 2009-10. The major oilseed crop of Maharashtra was groundnut till mid 1980s. However the data shows that since then, the farmers have started cultivating the non- conventional oilseed crop- such as soybean and sunflower. Soybean which contributed 7 percent to the total oilseed area and 10 percent to the oilseed production initially, now occupies 75 percent of the total oilseed area and 85 percent of the production. The area under this crop picked up at a fast rate primarily in the north east region of the state where the climatic conditions are suitable for soybean cultivation. The shorter duration of the crop (i.e. 3 to 3.5 months- from July to September/ October) allows the cultivators to take the second crop on the same piece of land and add to their income/profits, which is not possible for a kharif crop like Cotton. Being a purely commercial crop, it is not retained for home consumption. Similarly, it is not retained for the purpose of expulsion also as the processing requires a large operation unit and sophisticated technology. One time harvest of the crop makes the harvesting operation comparatively easier. Easy cultivation of the crop and benefits in terms of improvement in fertility also prompted farmers to undertake soybean cultivation. Soybean crop has been found to be very profitable as compared to other kharif, crops (Kajale, 2002). Cultivation of this crop is concentrated in two regions of Maharashtra, viz: Vidarbha and Marathwada. Around 80 percent of the soybean production of the state is contributed by these regions. The area under the crop is highest in the former regions specifically in Nagpur district. However, yield is seen to be higher for Kolhapur region, which receives irrigation on large scale.

Though Maharashtra is a major soybean producing state and though the yield of this crop is higher than that of many other major soybean growing states including Madhya Pradesh, the major problem faced by the cultivators is lack of irrigation facilities for the crop. In fact most of the crop is grown under rain fed conditions. In view of the growing demand for edible oils and growing dependence on imports for satisfying domestic demand, it is important to sustain and increase production of this crop. As there are limits to area expansion, the production has to increase through yield increase. Lack of irrigation to this crop seems to be one of the main constraints in increasing its production. Besides this factor, other economic, technological, agro-climatic and institutional factors are there, which can boost the production in a favourable policy environment.

11. Objectives of the Study

Considering the growing importance of the soybean crop in the cropping pattern and edible oil in the consumption basket, the basic objective of this study is to analyse the performance and potential of soybean crop sector and identify major problems/ constraints facing the sector in the state of Maharashtra. The specific objectives are as follows-

1. To examine trends and pattern of growth of soybean over time and across districts of Maharashtra and locate the sources of growth.

2. To calculate income and costs of the soybean cultivation on sample farms and compare the profitability of soybean crop with its competing crops.

3. To identify major constraints in soybean cultivation and suggest policy options to improve production and yields.

III. Methodology

It was decided to select major soybean producing districts that occupy at least 10 percent of the total state soybean area. The selection of districts was to be based on acreage and yield as per the following classification :

Crieterion for Selection of Sample Districts

Area	Yield	
	High	*Low*
High	High area-High yield (HH)	High area-Low yield (HL)
Low	Low area-High yield (LH)	Low are-Low yield (LL)

Since HH, HL and LH districts have potential for increasing production of oilseeds; it was proposed to select at least one district each from these three categories for household survey. Analysis of the data relating to area under soybean in Maharashtra revealed that HH and LH districts could be easily located; however, it was not possible to find districts in the HL category thus revealing that wherever yields are low (lower than the state average), area would not expand to a large extent. Based on the TE 2010-11 data, districts were ranked as per area under cultivation and yield and only 2 districts (one in each category) could be selected. Accordingly, district Kolhapur (LH) and district Amravati (HH district) were selected.

At second stage two major soybean producing talukas in each district and two villages in each of the talukas were selected on the basis of discussions with the district level and village level officials. From each selected village farmer households representing different farm categories (Marginal 0-1 ha, Small 1-2 ha, medium 2-10 ha; and Large> l0h) based on probability proportional to size based on size distribution at the state level were selected. A total of 250 households had to be selected from two districts. The 2005-06 data available at the time of the survey on landholding size depicted that around 44 percent of the households belonged the marginal category, 30 percent to the small category, around 25 percent to the medium category and less than one percent to above 10 hectares category. Given the number of households available at the time of survey in the villages, an attempt was made to select households in various categories in conformity with the state level classification of operational holdings. This is depicted in table 2 The landholding pattern of Maharashtra is dominated by marginal and small landholdings. The table shows that more than 70 percent of the farmers selected belong to marginal and small categories. Only one farmer having a large landholding could be located.

The field work was conducted in the above mentioned villages for the reference

TABLE 2: THE SAMPLING DESIGN

District	Taluka	Village	No. of sample households
Kolhapur	Hathanangle	Rukadi	25
		Male	25
	Gadhinglaj	Kadgaon	25
		Gijavane	25
		Total households	100
Amaravati	Amaravati	Dawargaon	37
		Nandura budruk	38
	NandgaonKhandeshwar	Jamgaon	37
		Mangarul Chavala	38
		Total households	150
Grand total			250

TABLE 3 : LAND SIZE WISE VILLAGE WISE SAMPLE HOUSEHOLDS SELECTED

District	Block	Village	Land Group				
Kolhapur			Marginal	Small	Medium	Large	All
	Hatkanangle	Rukadi	7	7	11	0	25
	Hatkanangle	Male	8	10	6	1	25
	Gadhinglaj	Kadgaon	14	8	3	0	25
	Gadhinglaj	Gijavane	12	7	6	0	25
		All	**41**	**32**	**26**	**1**	**100**
Amravati	Amravati	Dawargaon	14	1	22	0	37
	Amravati	Nandura Khurd	20	9	9	0	38
	Nandgaon-Khandeshwar	Jamgoan	12	14	10	0	36
	Nandgoan-Khandeshwar	Mangrul Chawala	23	14	2	0	39
		All	**69**	**38**	**43**	**0**	**150**
Total			**110**	**70**	**69**	**1**	**250**

IV. Major Findings of the Study

Major findings emerging from analysis of the secondary data are as follows:

1. The analysis of the secondary data highlights the changing cropping pattern of the state 1970s onwards till date. The analysis reveals that area under rice, wheat and pulses has increased over the concerned period. However, area under total cereals has declined due to a decline in area under coarse cereals by 23 percent which in turn is due to decline in area under jowar-the staple food crop of the state. As a result, there has

been a net decline in area under food grains by 2.55 percent. In case of non food grain crops, there is a marked increase in the area under total oilseeds which is contributed by soybean and sunflower. Apart from oil seeds, cotton as well as sugarcane have registered an area increase. In relative terms, share of food grains has declined from 69 percent to around 54 percent and that of total oilseeds has increased from 9 percent to 17 percent over the concerned period.

2. It is observed that the net increase in area is negligible, only 3 lakh ha during TE 1973-74 to 2009-10. In fact, the net sown area has declined during last two decades. The data reveals limits to area expansion. The net irrigated area has increased by 17 lakh ha, more than the NSA as the percentage of area irrigated is very low to begin with. It is seen that area irrigated more than once has not increased by the same extent as area sown more than once.

3. The area under soybean has increased in majority of the districts. The area under other major oilseed- groundnut has declined throughout the period. During the concerned period, the area under soybean crop has gone up by more than 25 lakh hectares and by 685 percent, which is the highest among the individual crops of the state. The incremental area under soybean is greater than that in total oilseeds, which again indicated diversion of area from crops other than oilseeds to soybean. Besides soybean, sugarcane, cotton, fruits and vegetables have emerged as important crops in the cropping pattern and consumption baskets.

TABLE 4—TRENDS IN AREA AND PRODUCTION OF MAJOR EDIBLE OILSEEDS IN MAHARASHTA DURING TE 1983-84 AND TE 2010-11

(Area in 00 ha, Prod. in 00 tonnes)

Crop	Area				Production			
	TE 1983-84	TE 1993-94	TE 2003-04	TE 2010-11	TE 1983-84	TE 1993-94	TE 2003-04	TE 2010-11
Grount nut	4983.33	5622.33	3428	2811 (–43.59)	3672	5079.33	3579	2957.67 (–19.45)
Sunflower	531.33	3373.67	2786.33	2607.33 (390.72)	364.67	2456.33	1249.67	1586.28 (334.99)
Seasmum	1064.61	2733.33	1177.67	676 (–36.50)	258.67	767.33	368.61	160.77 (–37.85)
Linseed	2391.33	1598.67	619	473.67 (–80.19)	480.67	319	156.33	120.19 (–74.99)
Safflower	–	4788.67	2648	2015.69 (–57.9)	–	2546	1142	1225.61 (–51.86)
Soybean	–	3710	13165	29153 (685.79)	–	3988.33	17267.33	26710.63 (569.72)
Total oilseeds	16038.67	25537.33	25356.67	39016.18	8747	17178.33	25007.33	34066.33

Note : Figures in the bracket indicate percentage change over the aggregate period.

Source : Calculated from District wise Statistical Information relating to agriculture, GOM, Season and Crop Reports, GOM various issues and data obtained from Office of the Commissioner of Agriculture, Pune Same as in table 1.4.

4. It is observed that the decade wise average area under soybean increased continuously and by around 108 percent during 1971-1981 and 2001-2010. The average production increased by 216 percent. However, the yield increased by only around 51 percent during the period and has been fluctuating through the period. Thus, the dominant area expansion effect is clearly observed. This underlines the need for stepping up yield of the oilseeds.

5. For the state as a whole, whereas in TE 1993-94, 68 percent of the area was under kharif oilseeds, it increased to 87 percent in TE 2009-10. This indicates area expansion of oilseeds that are rain fed and contraction of area under rabi oilseeds. Soybean is grown mainly in the rain fed regions. Hence area under kharif oilseeds has been growing throughout the period.

6. It is seen that at the state level, irrigated area under oilseeds has almost stayed constant during TE1993-94 and TE 2000 and it is only 10 percent of the total area under oilseeds.

7. The district wise and state level analysis of the secondary data reveals dominant position the soybean crop has come to occupy in the cropping pattern of the state. In TE 1993-94, only l.78 percent of the GCA was under this crop, in 2009-10, it has come to occupy almost 13 percent of the GCA. The area and production of the crop have grown by 20 percent and 14 percent respectively during 1984-85 and 2009-10. 78 percent of the acreage under total oilseeds is contributed by soybean. Studies have noted shift of area under kharif crops such as jowar, paddy, ground nut as well as cotton and sugarcane over the years towards this crop.

8. It is observed that soybean is grown mainly in the Vidarbha (Amravati and Nagpur divisions) and Marathwada (Latur and Aurangabad division) of the state. Nagpur was the dominant district and the division in early 1990s.This was followed by Kolhapur and Amravati divisions. However, share of Nagpur division declined continuously and that of Amravati increased. District Amravati is the district with highest share of area under soybean followed by Yavatmal and Nagpur. Share of Kolhapur division, which contributed around 18 percent to the state acreage in TE 1993-94, declined to around 5 percent in TE 2009-10. A similar pattern is observed as far as production of soybean is concerned. The share of districts in Kolhapur and Nagpur divisions has been reducing over a period of time. Currently, districts in Amravati division are major contributors - around 36 percent to the state soybean production. Amravati is the highest contributor to production and is followed by districts Nagpur and Buldhana.

   Amravati and Nagpur are also the regions wherein share of soybean in district edible oil seed acreage and production is very high- more than 90 percent. At the state level, around 78 percent of the edible oilseed area and 81 percent of edible oilseed production is contributed by soybean. Soybean is thus the dominant oilseed of the state.

9. Decade wise coefficient of variation was found for all the major oilseeds of the state. It is seen that the values of C.V. of soybean are higher than those of other oilseeds as area and production of soybean expanded at a high rate. It is also observed that the C.V. of soybean production is highest as compared to that of area and yield and variability is higher during the decade 1991-2000 when the growth rates in area, production and productivity are comparatively higher. Variability in area, production and productivity of soybean was compared with that of the competing crops. It is seen that for soybean and the competing crops, the variability in production is higher than that in area as well as yield. Variability in area, production and yield of soybean is very high in 1990s as the crop expanded rapidly in this decade.

10. For the state as a whole, growth rate of area under soybean was higher (19.31 percent) in 1990s than in the post 2000 period (13.61 percent) (table 5). It is also observed that growth rates of the leading districts in soybean cultivation such as Nagpur, Amravati, Yavatmal, Sangli, Kolhapur were relatively lower in post 2000 period than in the 1990s.In fact, Kolhapur and Sangli experienced negative growth rate in the post 2000 period. However, it is observed that area under soybean has been expanding in other districts also in the post 2000 period. As a result, more number of districts have experienced significant positive growth rate as compared to the earlier decade. As mentioned earlier, districts like Osmanabad, Nanded and Latur have exhibited significant growth in post 2000 period. For the period as a whole, Buldhana has exhibited highest growth rate and Beed has registered lowest growth rate of 5.67 percent.

    As against in case of area, it is noted that in majority of the districts, growth rates of production are lower in the post 2000 period than the earlier decade. As a result, growth rate for the state as a whole was 26.31 percent for the 1990s and has come down to 7.71 in the post 2000 period. It is also observed that the growth rates of production are lower than that of area in the post 2000 period.

TABLE 5—COMPOUND GROWTH RATE OF SOYABEAN AREA, PRODUCTION AND PRODUCTIVITY

	1990-91 to 1999-2000	2000-01 to 2009-10	Aggregate Period
Area	19.31	13.67	20.31
Production	26.31	7.71	14.25
Productivity	9.72	– 5.25	2.5

The exercise revealed that the growth rates of productivity are for most of the districts lower than those of area and production. This is because area has been expanding at a higher rate than production for most of the districts. In 1990s, all districts have registered a positive yield growth, which though is less than the area and production growth rate. However, it is observed that the growth rates of area and production - district wise as well as at the state level have slowed down in the post 2000 period. Similarly, the growth rate of productivity is negative / very low in most of the districts in the post 2000 period. Only three districts have registered positive and higher growth rate than that at the all India level.

11. It is seen that the prices of soybean have been gradually increasing through out the period. Prices of solvent extracted soybean oil and of solvent extracted refined soybean oil available for Indore and Mumbai market respectively also have been increasing gradually throughout the period. The pattern of increase in price of soybean and soybean oil is similar. Thus, change in the input price i.e. soybean- seems to have reflected in that of the final product-soybean oil. The available data on international prices of soybeans and soybean oil shows that international prices also are gradually increasing; with higher prices in 2007 and 2008 followed by a decline.

Following were the major findings that emerged from the analysis of the primary data.

12. It is observed that in all the farmer categories, more than 50 percent of the land is unirrigated. As a result, most of the land is under kharif crops. Apart from soybean, cotton, sugarcane, and moong are the major crops in the overall cropping pattern. The major source of irrigation is well. 71 percent of the irrigated land is under well irrigation indicating personal source of irrigation.

13. The analysis of the field level information collected from the sample households has revealed relative profitability of the soybean cultivation. The net income per hectare as well as per quintal is positive for all the land size categories. It is observed that the per hectare costs are higher for the large category farmer; similarly the yield is also very high- almost double that of the small and medium category farmers. As a result, the total value of output of the large farmer far exceeds the other category farmers. The net income per hectare for this category is around Rs. 14,000 and is more than double that of the other category farmers. The net returns from soybean cultivation were also found to be higher than those of the competing crops indicating relative profitability of the crop. The minimum support price for soybean in the year 2011-12 was Rs 1690 per ·Quintal which is lower than the average price received by the sample farmers. The available secondary data also indicates profitability in soybean cultivation.

TABLE 6—PROFITABILITY OF SOYBEAN

(Rs./per ha.)

Cost items	Soybean				
	Marginal	Small	Medium	Large	All Farms
Operational costs (Rs.)					
Seed	2404.61	2632.70	2622.23	2625.00	2625.00
	(11.02)	(11.11)	(11.91)	(7.30)	(11.61)
Fertiliser and manure	3734.55	4690.62	4068.62	5500.00	4101.52
	(17.12)	(19.79)	(18.49)	(15.30)	(18.13)

TABLE 6—PROFITABILITY OF SOYBEAN—*Contd.*

(Rs./per ha.)

Cost items	Soybean				
	Marginal	Small	Medium	Large	All Farms
Insecticides & pesticides	1475.69	836.13	872.14	1000.00	1128.13
	(6.77)	(3.53)	(3.96)	(2.78)	(4.99)
Human Labour	6675.28	7224.11	5991.93	10487.50	6655.60
	(30.60)	(30.48)	(27.22)	(29.18)	(29.43)
Family	3454.72	3718.30	1788.95	0.00	3054.95
Hired	3220.56	3505.82	4202.98	10487.50	3600.65
Machine labour	5145.77	5693.41	5951.95	10875.00	5615.83
	(23.59)	(24.03)	(27.04)	(30.26)	(24.82)
Bullock labour	2196.10	2475.28	2199.48	5450.00	2288.22
	(10.07)	(10.44)	(9.99)	(15.17)	(10.12)
Irrigation charges	179.66	149.38	302.87	0.00	204.47
	(0.82)	(0.63)	(1.38)	(0.00)	(0.90)
Total Operational Costs per ha.	21811.66	23701.64	22009.23	35937.50	22618.76
Cost of Production/q	1721.52	1560.35	1687.82	1437.50	1665.59
Yield (Quintals) per ha.	12.67	15.19	13.04	25	13.58
Price of the produce sold	2122.90	2052.77	2108.41	2000.00	2071.20
Total Value of Production	26897.17	31181.57	27493.64	50000.00	28124.45
Net income hectare	5085.51	7479.93	5484.41	14062.50	5505.69
Net returns per quintal	401.38	492.42	420.59	562.5	405.43
Minimum Support Price 2011-12 (Rs./qtl.)			1690		

Note : Values of interest on working capital and of by-product were not reported.

14. Table 7 shows percentage change in minimum support price(MSP), wholesale price index (WPI) and gross returns (GR) of kharif crops at all India Level. Values relating to percentage change in MSP, WPI and GR do not clearly bring out profitability of soybean. As soybean is a short duration crop, it yields income after a short span. Thus, the monthly income from this crop would be relatively higher than other kharif crops that are generally harvested in after November i.e. 6 months. Therefore, monthly GR of the crops were also calculated. It is seen to be higher for soybean than all other crops concerned for the 1990-91 and 2008-09.This appears to be an indication of relative profitability of soybean crop can be assumed to be true for all soybean growing states including Maharashtra.

TABLE 7—PERCENTAGE CHANGE IN MSP, WHOLESALE PRICE INDEX AND GROSS RETURNS OF KHARIF CROPS AT ALL INDIA LEVEL

Crop	%change in MSP	%change in WPI	Gross Returns per hectare (Rs.)		%change	Monthly Gross Returns (Rs.)	
	1990-91 to 2008-09	1993-94 to 2008-09	1990-91	2008-09	1990-91 to 2008-09	(1990-91)	(2008-09)
Paddy	339	110 (rice)	5303	28959	446	883.83	4826.5
Jowar Hybrid	366.7	231.03 (Jowar)	1428	7686	438	238	1281
Groundnut	262.1	151.31	5734	24822	332	955.67	4137
Yellow Soybean	247.5	227.14	3612	15624	332	1204	5208
Cotton H4	300	—	5107	15570	204	851.17	2595

Source : GoI(2010)

It is also observed that most of the farmers have been using HYV seeds and area under these seeds is more than 90 percent in each category. However, 50 percent or more of them are not aware whether they are using recommended doses of fertilizers thus highlighting need for a strong extension machinery. It is also noted from the table that the awareness about MSP for soybean is very poor. This may be because of higher (than MSP) prices of soybean prevailing in the market. Therefore it was observed that majority of the farmers were unaware of the price realization in comparison with the MSP. When asked about marketing problems, more than 60 percent in each category reported that they faced marketing problems.

15. Most of the farmers have bought the seed from Krishi Seva Kendra and/or the universities indicating that the seeds may be of good quality. Another major input is extension service provided by different agencies. More than 50 percent of the respondents in various categories have reported state agency as the main source of extension. However, in view of the responses relating to MSP and recommended doses of fertilizer, it is felt that the outreach of the extension services needs to be strengthened. For around one fourth of the respondents, major source of extension is the input dealer. As for the market information, the fellow farmers and commission agents are seen to be important sources of information.

16. It is observed that the yield gap I(experimental yield-actual yield) is not very high and if ideal conditions are provided, it can equalize the experimental yield. It is seen that yield gap II(potential yield- actual yield) is very low for the large farmer and comparatively higher for the marginal farmers. More than 75 percent of the land under soybean on sample farms is unirrigated. It is likely that provision of irrigation to these farms would increase the yield leading to reduction in yield gap.

TABLE 8—YIELD GAP ANALYSIS (QUINTALS)

Yield/Yield Gap	Marginal	Small	Medium	Large	All Farms
1. Experimental Farm			30		
2. Potential Farm yield			28		
3. Actual Farm Yield	12.67	15.19	13.04	25	13.58
Yield Gap I (1-3)			2		
Yield Gap II (2-3)	15.33	12.81	14.96	3	14.42

Source : 1. For experimental farm yield GoM, 2011, 2. For potential farm yield, Discussions with various officials, field survey.

17. As per the responses, economic factors (high input costs, shortage of human labour, price related risks) turn out to be important constraints on soybean cultivation. The analysis also reveals that the constraint wise indices are higher for the marginal farmers. This indicates that the severity of the constraints is highest for the marginal farmers and lowest far the large category farmers. Responses relating constraints also show that soybean is comparatively a less risky and more profitable crop.

18. The respondent farmers were asked their suggestions for improving production and yield. More than one third of the farmers in all the categories (except that in the large category) demanded that agricultural inputs should be provided by the government at'lower rates. This particular suggestion is in response to the rising prices of inputs and poor quality inputs supplied in the market which affect the profitability adversely. More over more than 20 percent of the farmers in all the categories felt that irrigation facilities should be provided. It can be noted that only around 25 percent of the land under soybean was irrigated. This suggestion therefore was in view of extent of irrigation available for the soybean cultivators.

Discussions with the soybean cultivators reveals that soybean cultivation is indeed profitable. However, given the fact that the growth rates of production and productivity of soybean in Maharashtra are declining, the profitability of soybean cultivators needs to be maintained. Provision of irrigation and a strong extension machinery may lead to an increase of the yield and reduce yield gap especially in case of the marginal farmers.

V. Conclusions

The study reveals that in view of the supply side as well as demand side factors, area under soybean and its production are increasing in all the major soybean growing districts and hence at the state level. However, the growth rate of yield is declining revealing that growth rate of area expansion is more than that of production. This calls for a strategy for arresting the decline in yield observed for the post 2000 period i.e. during 2001-02 to 2009-10.

The primary data analysis highlights relative profitability of soybean, which is also supported by findings of the CACP at all India level. However, the farmers face several constraints, economic constraints being the important ones.

VI. Policy Implications

Following are the policy suggestions that emerge from the study.

1. The secondary data analysis has revealed greater role of area expansion in comparison with yields enhancement. There is an urgent need to increase productivity of soybean through provision of irrigation, quality seeds and extension regarding correct mix of quality inputs. The analysis of the data relating to the sample households has also revealed that only 44 percent of the GCA was under irrigation and the major source of irrigation was personal i.e. well. It is felt that to sustain the current level of production at the state level, productivity needs to be stepped up and provision of irrigation is on one of the important measures that can be taken up.

2. The major constraints faced by the soybean cultivators are the economic constraints. This includes high input costs, shortage of human labour and price related risks. It is also found that the severity of the constraints is higher for the marginal farmers. It is therefore felt that the existing government schemes relating to provision of inputs/ input subsidies should be implemented properly.

3. The farmers also reported that they faced problems as far as supply of inputs, their timely availability and quality is concerned. Though it may be difficult to control the open market prices of inputs, the government should ensure that good quality inputs are provided in time.

4. Responses of the farmers show that more than 50 percent of the farmers do not know if they are using recommended doses of fertilizers and whether the price received by them is greater than or lower than the MSP declared for soybean. The former information is important for the farmers for increasing yield whereas the latter is needed for maintaining market information. The extension machinery of the state needs to be strengthened.

5. Incidence of diseases, incidence of pests and weeds infestation was a moderate constraint. This again calls for a strong extension machinery for dissemination of information regarding diseases and pests.

6. More than 60 percent of the farmers reported that they faced problems relating to marketing. Lack of proper marketing facilities, exploitation by the intermediaries, lack of information about market prices were some other constraints. In view of this, dissemination of market information by state agencies and private agencies assumes great significance.

Soybean is on its road to become the most important crop in the cropping pattern of Maharashtra. Hence sustaining its growth would be beneficial not only for the farmers but also for the consumers and the agricultural sector as a whole.

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D. Commodity Reviews

(i) Foodgrains

During the month of October, 2013 the Wholesale Price Index (Base 2004-05=100) of pulses, Foodgrains and cereals increased by 0.89%, 0.75% and 0.75% respectively over the previous month.

ALL INDIA WHOLESALE PRICES INDEX (WPI) NUMBER

(Base : 2004-2005=100)

Commodity	Weight (%)	WPI for the Month of October, 2013	WPI for the Month of September, 2013	WPI A year ago	Percentage change during	
					A month	A year
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Rice	1.793	234.5	231.7	202.7	1.21	15.69
Wheat	1.116	213.6	210.1	198.0	1.67	7.88
Jowar	0.096	240.8	241.2	234.6	– 0.17	2.64
Bajra	0.115	251.6	251.4	221.0	0.08	13.85
Maize	0.217	246.0	259.8	232.2	– 5.31	5.94
Barley	0.017	214.7	213.4	198.4	0.61	8.22
Ragi	0.019	330.1	348.9	284.8	– 5.39	15.91
Cereals	3.373	229.6	227.9	205.0	0.75	12.00
Pulses	0.717	227.8	225.8	256.5	0.89	– 11.19
Foodgrains	4.09	229.2	227.5	214.1	0.75	7.05

Source : Office of the Economic Adviser, M/o Commerce and Industry.

Behaviour of Wholesale Prices

The following Table indicates the State wise trend of Wholesale Prices of Cereals during the month of October, 2013.

Commodity	Main Trend	Rising	Falling	Mixed	Steady
Rice	Mixed & Steady			Haryana	Gujarat
Wheat	Rising	Gujarat Haryana M.P. Rajasthan	Jharkhand Karnataka Maharashtra		
Jowar	Rising & Mixed	Gujarat		Gujarat	
Bajra	Falling	Rajasthan	Karnataka	Karnataka	
Maize	Falling	A.P.	Gujarat U.P.	Rajasthan	Karnataka

Procurement of Rice

The total procurement of Rice in the current marketing season i.e 2013-2014, upto 31.10.2013 stood at 8.00 million tonnes, as against 7.94 million tonnes of rice procured, during the corresponding period of last year. The details are given in the following table.

PROCUREMENT OF RICE

(in thousand tonnes)

State	Marketing Season 2013-14 (upto 31-10-2013)		Corresponding Period of last Year 2012-13		Marketing Year (October-September) 2012-13		Marketing Year (October-September) 2011-12	
	Procure-ment	Percentage to Total	Procure-ment	Percentage to Total	Procure-ment	Percentage to Total	Procure-ment	Percentage to Total
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Andhra Pradesh	0	0.00	0	0.00	6464	19.00	7548	21.53
Chhatisgarh	0	0.00	0	0.00	4804	14.12	4115	11.74
Haryana	2170	27.10	2101	26.46	2609	7.67	2007	5.72
Maharashtra	0	0.00	0	0.00	192	0.56	190	0.54
Punjab	5779	72.18	5825	73.37	8558	25.16	7731	22.05
Tamil Nadu	43	0.54	1	0.01	481	1.41	1596	4.55
Uttar Pradesh	5	0.06	1	0.01	2286	6.72	3357	9.58
Uttarakhand	0	0.00	1	0.01	497	1.46	378	1.08
Others	9	0.11	10	0.13	8129	23.89	8138	23.21
Total	**8006**	100.00	**7939**	100.00	**34020**	100.00	**35060**	100.00

Source: Department of Food and Public Distribution.

Procurement of Wheat

The total procurement of wheat in the current marketing season i.e 2013-2014 upto August, 2013 is 25.09 million tonnes against a total of 38.11 million tonnes of wheat procured during corresponding last year. The details are given in the following table :

PROCUREMENT OF WHEAT

(in thousand tonnes)

State	Marketing Season 2013-14 (upto 01-08-2013)		Corresponding Period of last Year (2012-13)		Marketing Year (April-March) 2012-13		Marketing Year (April-March) 2011-12	
	Procure-ment	Percentage to Total	Procure-ment	Percentage to Total	Procure-ment	Percentage to Total	Procure-ment	Percentage to Total
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Haryana	5873	23.41	8666	22.74	8665	22.71	6928	24.45
Madhya Pradesh	6355	25.33	8507	22.32	8493	22.26	4965	17.52
Punjab	10897	43.43	12836	33.68	12834	33.64	10958	38.67
Rajasthan	1268	5.05	1964	5.15	1964	5.15	1303	4.60
Uttar Pradesh	683	2.72	5063	13.29	5063	13.27	3461	12.21
Others	16	0.06	1071	2.81	1129	2.96	720	2.54
Total	**25092**	100.00	**38107**	100.00	**38148**	100.00	**28335**	100.00

Source: Department of Food and Public Distribution.

PART II—Statistical Tables

A. Wages

1. Daily Agricultural Wages in Some States (Category-wise)

(in Rupees)

State/Distt.	Village	Month and Year	Normal Daily Working Hours	Field Labour			Other Agri. Labour			Herdsman			Skilled Labour		
				Man	Wo-man	Non Adult	Man	Wo-man	Non Adult	Man	Wo-man	Non Adult	Car-penter	Black-smith	Cob-bler
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Andhra Pradesh															
Krishna	Ghantasala	May., 2013	8	250.00	150	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Guntur	Tadikonda	May., 2013	8	NA	NA	NA	NA	NA	NA	200.00	NA	NA	NA	NA	NA
Rangareddy	Arutla	May, 2013	8	225.00	175.00	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Karnataka															
Bangalore	Harisandra	May to June, 2012	8	200.00	150.00	NA	200.00	150.00	NA	250.00	180.00	NA	300.00	300.00	NA
Tumkur	Gedlahali	May to June, 2012	8	160.00	160.00	NA	180.00	160.00	NA	180.00	160.00	NA	180.00	180.00	NA
Maharashtra															
Nagpur	Mauda	Feb., 2012	8	100.00	100.00	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ahmednagar	Akole	Feb, 2012	8	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Jharkhand															
Ranchi	Gaintalsood	April, 2012	8	100.00	100.00	NA	90.00	90.00	NA	58.00	58.00	NA	170.00	150.00	NA

1.1 Daily Agricultural Wages in Some States (Operation-wise)

(in Rupees)

State/Distt.	Centre	Month and Year	Type of Lab-our	Normal Daily Work-ing Hours	Plough-ing	Sow-ing	Weed-ing	Harvest-ing	Other Agri. Labour	Herds-man	Skilled Labour		
											Car-penter	Black-smith	Cob-bler
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Assam													
Barpeta	Loharapara	March, 2012	M	8	180.00	180.00	180.00	180.00	180.00	180.00	180.00	180.00	180.00
			W	8	NA	NA	160.00	160.00	160.00	NA	NA	NA	NA
Bihar													
Muzaffarpur	Bhalui Rasul	April to,	M	8	130.00	120.00	80.00	130.00	150.00	120.00	200.00	180.00	250.00
		June, 2012	W	8	NA	NA	NA	NA	NA	NA	NA	NA	NA
Shekhpura	Kutaut	May and	M	8	NA	NA	185.00	NA	185.00	NA	245.00	NA	NA
		June, 2012	W	8	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chhattisgarh													
Dhamtari	Sihaba	June, 2013	M	8	400.00	100.00	NA	NA	80.00	80.00	250.00	100.00	100.00
			W	8	NA	80.00	NA	NA	70.00	80.00	150.00	NA	NA
Gujarat													
Rajkot	Rajkot	Jan., 2013	M	8	209.00	225.00	150.00	170.00	147.00	150.00	360.00	360.00	240.00
			W	8	NA	169.00	150.00	179.00	145.00	142.00	NA	NA	NA
Dahod	Dahod	Jan., 2013	M	8	100.00	100.00	100.00	100.00	100.00	NA	200.00	144.00	150.00
			W	8	NA	100.00	100.00	100.00	100.00	NA	NA	NA	NA
Haryana													
Panipat	Ugarakheri	March, 2013	M	8	180.00	180.00	180.00	200.00	180.00	NA	400.00	400.00	NA
			W	8	NA	150.00	150.00	180.00	150.00	NA	NA	NA	NA

1.1 Daily Agricultural Wages in Some States (Operation-wise)—*Contd.*

(in Rupees)

State/Distt.	Centre	Month and Year	Type of Labour	Normal Daily Working Hours	Ploughing	Sowing	Weeding	Harvesting	Other Agri. Labour	Herdsman	Skilled Labour		
											Carpenter	Blacksmith	Cobbler
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Himachal Pradesh													
Mandi	Mandi	Nov., to Dec. 2010	M		300.00	110.00	110.00	110.00	110.00	110.00	200.00	200.00	NA
			W		NA	110.00	110.00	110.00	110.00	110.00	NA	NA	NA
Kerala													
Kozhikode	Koduvally	April., 2013	M	4 to 8	920.00	550.00	NA	550.00	710.00	NA	650.00	NA	NA
			W	4 to 8	NA	NA	450.00	450.00	500.00	NA	NA	NA	NA
Palakkad	Elappally	April, 2013	M	4 to 8	NA	NA	NA	400.00	400.00	NA	500.00	NA	NA
			W	4 to 8	NA	NA	NA	300.00	200.00	NA	NA	NA	NA
Madhya Pradesh													
Hoshangabad	Sangarkhera	June, 2013	M	8	150.00	100.00	100.00	160.00	100.00	100.00	350.00	350.00	NA
			W	8	NA	100.00	100.00	160.00	100.00	100.00	NA	NA	NA
Satna	Kotar	June, 2013	M	8					—NA—				
			W	8					—NA—				
Shyopur Kala	Vijaypur	June, 2013	M	8	150.00	NA	NA	NA	NA	50.00	200.00	200.00	NA
			W	8	NA	NA	NA	NA	NA	NA	NA	NA	NA
Odisha													
Bhadrak	Chandbali	April, 2013	M	8	150.00	NA	NA	160.00	216.66	150.00	250.00	180.00	150.00
			W	8	NA	NA	NA	120.00	175.00	140.00	NA	NA	NA
Ganjam	Aska	April, 2013	M	8	200.00	200.00	200.00	200.00	203.33	200.00	350.00	250.00	300.00
			W	8	NA	100.00	150.00	150.00	120.00	100.00	NA	NA	NA
Punjab													
Ludhiana	Pakhowal	June, 2008	M	8	NA	NA	90.00	95.00	NA	99.44	NA	NA	NA
			W		NA	NA	NA	NA	NA	NA	NA	NA	NA
Rajasthan													
Barmer	Vishala	June, 2013	M	8					—NA—				
			W	8					—NA—				
Jalore	Panwa	June, 2013	M	8	NA	NA	NA	NA	NA	200.00	350.00	300.00	NA
			W	8	NA	NA	NA	NA	NA	NA	NA	NA	NA
Tamil Nadu													
Thanjavur#	Pulvarnatham	May, 2013	M	6	NA	300.00	NA	300.00	278.54	NA	NA	NA	NA
			W	5	NA	NA	108.33	104.17	108.33	NA	NA	NA	NA
Tirunelveli#	Malayakulam	May, 2013	M	8	NA	NA	250.00	200.00	388.31	NA	NA	NA	NA
			W	8	NA	NA	140.00	125.00	241.5	NA	NA	NA	NA
Tripura													
State average		Apr. 2011 to March, 2012	M	8	238.00	201.00	203.00	209.00	207.00	199.00	253.00	235.00	240.00
			W	8	NA	154.00	152.00	154.00	154.00	149.00	NA	NA	NA
*Uttar Pradesh**													
Meerut	Ganeshpur	Jan., 2013	M	8	205.00	207.00	206.00	204.00	206.00	NA	320.00	NA	NA
			W	8	NA	180.00	180.00	180.00	180.00	NA	NA	NA	NA
Aurraiya	Aurraiya	Jan., 2013	M	8	150.00	193.00	192.00	150.00	193.00	NA	300.00	NA	NA
			W	8	NA	160.00	167.00	120.00	167.00	NA	NA	NA	NA
Chandauli	Chandauli	Jan., 2013	M	8	150.00	150.00	125.00	125.00	125.00	NA	271.00	NA	NA
			W	8	NA	150.00	125.00	125.00	125.00	NA	NA	NA	NA

M-Man W-Woman

N. A. —Not Available N. R. —Not Reported

*- Uttar Pradesh reports its district-wise average rural wage data rather than from selected centre/village.

- Tamil Nadu reports its district-wise average rural wage data rather than from selected centre/village.

B. PRICES

2. Wholesale Prices of Certain Agricultural Commodities and Animal Husbandry Products at Selected Centres in India

(Month-end Prices in Rupees)

Commodity	Variety	Unit	State	Centre	Oct..-13	Sept.-13	Oct.-12
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Wheat	PBW 343	Quintal	Punjab	Amritsar	1500	1450	1450
Wheat	Dara	Quintal	Uttar Pradesh	Chandausi	1500	1500	1400
Wheat	Lokvan	Quintal	Madhya Pradesh	Bhopal	1780	1525	1550
Jowar	—	Quintal	Maharashtra	Mumbai	2450	2400	2000
Gram	No III	Quintal	Madhya Pradesh	Sehore	2830	3200	3000
Maize	Yellow	Quintal	Uttar Pradesh	Kanpur	NA	1340	1240
Gram Split	—	Quintal	Bihar	Patna	4650	4650	5400
Gram Split	—	Quintal	Maharashtra	Mumbai	5800	5700	6350
Arhar Split	—	Quintal	Bihar	Patna	6750	6390	5900
Arhar Split	—	Quintal	Maharashtra	Mumbai	6500	6300	6625
Arhar Split	—	Quintal	NCT of Delhi	Delhi	6225	6150	6700
Arhar Split	Sort II	Quintal	Tamil Nadu	Chennai	6700	6420	6000
Gur	—	Quintal	Maharashtra	Mumbai	3420	3480	3400
Gur	Sort II	Quintal	Tamil Nadu	Coimbatore	4000	4000	3100
Gur	Balti	Quintal	Uttar Pradesh	Hapur	2875	3340	2675
Mustard Seed	Black (S)	Quintal	Uttar Pradesh	Kanpur	3250	3200	4120
Mustard Seed	Black	Quintal	West Bengal	Raniganj	3700	3700	4600
Mustard Seed	—	Quintal	West Bengal	Kolkata	3900	3900	4300
Linseed	Bada Dana	Quintal	Uttar Pradesh	Kanpur	4125	4100	4350
Linseed	Small	Quintal	Uttar Pradesh	Varanasi	3690	3685	3625
Cotton Seed	Mixed	Quintal	Tamil Nadu	Virudhunagar	1900	1850	1600
Cotton Seed	MCU5	Quintal	Tamil Nadu	Coimbatore	1550	1550	1550
Castor Seed	—	Quintal	Andhra Pradesh	Hyderabad	3150	3050	3200
Sesamum Seed	White	Quintal	Uttar Pradesh	Varanasi	6685	6600	6600
Copra	FAQ	Quintal	Kerala	Alleppey	6600	5825	4100
Groundnut	Pods	Quintal	Tamil Nadu	Coimbatore	3800	3800	3850
Groundnut	—	Quintal	Maharashtra	Mumbai	7400	7000	8200
Mustard Oil	—	15 Kg.	Uttar Pradesh	Kanpur	1179	1164	1335
Mustard Oil	Ordinary	15 Kg.	West Benaal	Kolkata	1215	1215	1403
Groundnut Oil	—	15 Kg.	Maharashtra	Mumbai	1350	1350	1695
Groundnut Oil	Ordinary	15 Kg.	Tamil Nadu	Chennai	1313	1350	1725
Linseed Oil	—	15 Kg.	Uttar Pradesh	Kanpur	1230	1208	1467
Castor Oil	—	15 Kg.	Andhra Pradesh	Hyderabad	1080	1073	1125
Sesamum Oil	—	15 Kg.	NCT of Delhi	Delhi	1400	1400	1400
Sesamum Oil	Ordinary	15 Kg.	Tamil Nadu	Chennai	2700	2460	2175
Coconut Oil	—	15 Kg.	Kerala	Cochin	1425	1260	900
Mustard Cake	—	Quintal	Uttar Pradesh	Kanpur	1690	1650	2170
Groundnut Cake	—	Quintal	Andhra Pradesh	Hyderabad	2571	2929	3143
Cotton/Kapas	NH44	Quintal	Andhra Pradesh	Nandyal	3800	4500	3600
Cotton/Kapas	LRA	Quintal	Tamil Nadu	Virudhunagar	NT	NT	NT
Jute Raw	TD5	Quintal	West Benaal	Kolkata	2645	2620	2450
Jute Raw	W5	Quintal	West Benaal	Kolkata	2595	2570	2450
Oranges	—	100 No	NCT of Delhi	Delhi	500	NA	542

2. Wholesale Prices of Certain Agricultural Commodities and Animal Husbandry Products at Selected Centres in India—*Contd.*

(Month-end Prices in Rupees)

Commodity	Variety	Unit	State	Centre	Oct-13	Sept.-13	Oct.-12
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Oranges	Big	100 No	Tamil Nadu	Chennai	580	640	600
Oranges	Nagpuri	100 No	West Bengal	Kolkata	NA	NA	NA
Banana	—	100 No.	NCT of Delhi	Delhi	250	208	183
Banana	Medium	100 No.	Tamil Nadu	Kodaikkanal	420	415	328
Cashewnuts	Raw	Quintal	Maharashtra	Mumbai	57500	55000	50000
Almonds	—	Quintal	Maharashtra	Mumbai	59000	53000	45500
Walnuts	—	Quintal	Maharashtra	Mumbai	67500	66250	51250
Kishmish	—	Quintal	Maharashtra	Mumbai	13500	13100	11000
Peas Green	—	Quintal	Maharashtra	Mumbai	4700	4300	3350
Tomatoes	Ripe	Quintal	Uttar Pradesh	Kanpur	2200	1950	1350
Ladyfinger	—	Quintal	Tamil Nadu	Chennai	2000	2300	2000
Cauliflower	—	100 No.	Tamil Nadu	Chennai	1800	1700	1100
Potatoes	Red	Quintal	Bihar	Patna	1250	980	1200
Potatoes	Desi	Quintal	West Bengal	Kolkata	1400	800	1200
Potatoes	Sort I	Quintal	Tamil Nadu	Mettuppalayam	2341	NA	2365
Onions	Pole	Quintal	Maharashtra	Nashik	3200	4250	450
Turmeric	Nadan	Quintal	Kerala	Cochin	10000	10000	8200
Turmeric	Salam	Quintal	Tamil Nadu	Chennai	9400	9400	7000
Chillies	—	Quintal	Bihar	Patna	8000	8000	7100
Black Pepper	Nadan	Quintal	Kerala	Kozhikode	45000	38500	39000
Ginger	Dry	Quintal	Kerala	Cochin	15500	15500	11250
Cardamom	Major	Quintal	NCT of Delhi	Delhi	120000	113000	75000
Cardamom	Small	Quintal	West Bengal	Kolkata	95000	95000	100000
Milk	Cow	100 Liters	NCT of Delhi	Delhi	NA	NA	3600
Milk	Buffalo	100 Liters	West Bengal	Kolkata	3600	3600	3200
Ghee Deshi	Deshi No 1	Quintal	NCT of Delhi	Delhi	28681	28681	26413
Ghee Deshi	—	Quintal	Maharashtra	Mumbai	30500	30500	NA
Ghee Deshi	Desi	Quintal	Uttar Pradesh	Kanpur	30600	30250	28650
Fish	Rohu	Quintal	NCT of Delhi	Delhi	10000	7000	10000
Fish	Pomphrets	Quintal	Tamil Nadu	Chennai	29000	28000	23500
Eggs	Madras	1000 No,	West Bengal	Kolkata	3800	3800	4000
Tea	—	Quintal	Bihar	Patna	20000	20000	19800
Tea	Atti Kunna	Quintal	Tamil Nadu	Coimbatore	9000	9000	NA
Coffee	Plant-A	Quintal	Tamil Nadu	Coimbatore	26000	26000	26000
Coffee	Rubusta	Quintal	Tamil Nadu	Coimbatore	14000	14000	14000
Tobacco	Kampila	Quintal	Uttar Pradesh	Farukhabad	2850	2825	2700
Tobacco	Raisa	Quintal	Uttar Pradesh	Farukhabad	2750	2700	2530
Tobacco	Bidi Tobacco	Quintal	West Bengal	Kolkata	3700	3700	4000
Rubber	—	Quintal	Kerala	Kottayam	14900	16200	16700
Arecanut	Pheton	Quintal	Tamil Nadu	Chennai	29000	29000	28000

3. Month-end Wholesale Prices of Some Important Agricultural Commodities in International Markets During Year, 2013

Commodity	Variety	Country		Centre	Jan.	Feb.	Mar.	Apr.	May	June	Jul.	Aug.	Sep.	Oct.
Cardamom	Guatmala Bold	U.K.	—	Dollar/M.T.	16500.00	16500.00	16500.00	17000.00	14250.00	14250.00	14250.00	14250.00	14250.00	14250.00
	Green			Rs./Qtl.	88572.00	89875.50	89743.50	92174.00	80341.50	85770.75	84018.00	96030.75	87965.25	87566.25
Cashew	Spot U.K.	U.K.	—	Dollar/1bs	3.60	3.60	3.66	3.64	3.55	3.56	3.55	3.50	3.47	3.49
Kernels	320s			Rs./Qtl.	42591.86	43218.68	43874.45	43498.32	44112.84	47226.52	46131.48	51984.65	47210.36	47267.09
	Spot U.K.	U.K.	—	Dollar/M.T.	7915.09	7898.35	8056.22	8024.08	7861.23	7844.30	7869.32	7719.15	7633.83	7705.14
	320s			Rs./Qtl.	42488.20	43022.31	43817.78	43506.56	44321.61	47214.84	46397.51	52019.35	47123.63	47348.09
Castor Oil	Any Origin ex	Nether-	—	Dollar/M.T.	1690.00	1650.00	1650.00	1600.00	1500.00	1510.00	1480.00	1420.00	1440.00	1470.00
	tank Rotterdam	lands		Rs./Qtl.	9071.92	8987.55	8974.35	8675.20	8457.00	9088.69	8726.08	9569.38	8889.12	9033.15
Celery Seed	ASTA cif	India	—	Dollar/M.T.	1500.00	1500.00	1500.00	1500.00	1500.00	1500.00	1500.00	1500.00	1500.00	1500.00
				Rs./Qtl.	8052.00	8170.50	8158.50	8133.00	8457.00	9028.50	8844.00	10108.50	9259.50	9217.50
Chillies	Birds eye 2005	Africa	—	Dollar/M.T.	5000.00	4250.00	4250.00	4100.00	4100.00	4100.00	4100.00	4100.00	4100.00	4100.00
	crop			Rs./Qtl.	26840.00	23149.75	23115.75	22230.20	23115.80	24677.90	24173.60	27629.90	25309.30	25194.50
Cinnamon		Mada-	—	Dollar/M.T.	1100.00	1100.00	1100.00	1100.00	1100.00	1100.00	1100.00	1100.00	1100.00	1100.00
Bark		gascar		Rs./Qtl.	5904.80	5991.70	5982.90	5964.20	6201.80	6620.90	6485.60	7412.90	6790.30	6759.50
Cloves	Singapore	Mada-	—	Dollar/M.T.	9500.00	9500.00	9500.00	12000.00	12000.00	11850.00	13500.00	13500.00	12800.00	12000.00
		gascar		Rs./Qtl.	50996.00	51746.50	51670.50	65064.00	67656.00	71325.15	79596.00	90976.50	79014.40	73740.00
Coconut	Crude	Nether-	—	Dollar/M.T.	815.00	850.00	805.00	800.00	850.00	890.00	850.00	930.00	990.00	1000.00
Oil	Phillipine/ Indonesia	lands		Rs./Qtl.	4374.92	4629.95	4378.40	4337.60	4792.30	5356.91	5011.60	6267.27	6111.27	6145.00
Copra	Phillipines	Philli	—	Dollar/M.T.	538.00	530.00	505.00	476.00	527.00	559.00	546.00	578.00	616.00	622.50
	cif Rotterdam	pine		Rs./Qtl.	2887.98	2886.91	2746.70	2580.87	2971.23	3364.62	3219.22	3895.14	3802.57	3825.26
Corriander		India	—	Dollar/M.T.	1150.00	1150.00	1150.00	1150.00	1150.00	1150.00	1150.00	1150.00	1150.00	1150.00
				Rs./Qtl.	6173.20	6264.05	6254.85	6235.30	6483.70	6921.85	6780.40	7749.85	7098.95	7066.75
Cummin		India	—	Dollar.M.T.	2889.00	2889.00	2889.00	289.00	2889.00	2889.00	2889.00	2889.00	2889.00	2889.00
Seed				Rs./Qtl.	15508.15	15736.38	15713.27	15664.16	16288.18	17388.89	17033.54	19468.97	17833.80	17752.91
Fennel seed		India	—	Dollar/M.T.	2600.00	2600.00	2600.00	2600.00	2600.00	2600.00	2600.00	2600.00	2600.00	2600.00
				Rs./Qtl.	13956.80	14162.20	14141.40	14097.20	14658.80	15649.40	15329.60	17521.40	16049.80	15977.00
Ginger	Split	Nigeria	—	Dollar/M.T.	2400.00	2400.00	2400.00	2400.00	1810.00	2005.00	2300.00	2300.00	2300.00	2000.00
				Rs./Qtl.	12883.20	13072.80	13053.60	13012.80	10204.78	12068.10	13560.80	15499.70	14197.90	12290.00
Groundnut	US 2005, 40/50	European	—	Dollar/M.T	1275.00	1350.00			1350.00	1380.00	1400.00	1310.00	1350.00	1450.00
kernels	cif Rotterdam	Ports		Rs./Qtl.	6844.20	7353.45	–	–	7611.30	8306.22	8254.40	8828.09	8333.55	8910.25
Groundnut	Crude Any	U.K.	—	Dollar/M.T	2200.00						1700.00	1700.00	1700.00	1600.00
Oil	Ori gin cif Rotterdam			Rs./Qtl.	11809.60	–	–	–	–	–	10023.20	11456.30	10494.10	9832.00
Lentils	Turkish Red	U.K.	—	Pound/M.T	522.72	655.20	660.98	647.80	656.64	655.38	650.12	644.89	623.54	617.25
	Split Crop 1+1 water			Rs./Qtl.	4428.48	5446.68	5438.54	5422.09	6537.91	6019.01	5895.94	6739.10	6173.05	6144.72
Maize		U.S.A	Chic-	C/56 lbs.	720.75	700.50	735.25	639.50	665.00	664.50	508.25	504.25	454.75	442.75
			ago	Rs./Qtl	1520.51	1499.54	1571.62	1362.68	1473.46	1571.85	1177.68	1335.47	1103.22	1069.23
Oats		Canada	Winni-	Dollar/M.T.	359.83	384.62	406.44	401.94	366.25	405.76	362.84	389.94	319.38	355.48
			peg	Rs./Qtl.	1931.57	2095.03	2210.63	2179.32	2064.92	2442.27	2139.30	2027.81	1971.53	2184.42
Palm Kernal	Crude	Nether-	—	Dollar/M.T.	795.00	855.00	815.00	840.00	840.00	840.00	830.00	905.00	895.00	925.00
Oil	Malaysia/ Indonesia	lands	—	Rs./Qtl.	4267.56	4657.19	4432.79	4554.48	4735.92	5055.96	4893.68	6098.80	5524.84	5684.13

3. Month-end Wholesale Prices of Some Important Agricultural Commodities in International Markets During Year, 2013—*Contd.*

Commodity	Variety	Country		Centre	Jan.	Feb.	Mar.	Apr.	May	June	Jul.	Aug.	Sep.	Oct.
Palm Oil	Crude	Nether-	—	Dollar/M.T.	855.00	860.00	850.00	830.00	860.00	855.00	825.00	850.00	820.00	900.00
	Malaysian/ Sumatra	lands	—	Rs./Qtl.	4589.64	4684.42	4623.15	4500.26	4848.68	5146.25	4864.20	5728.5	5061.86	5530.50
Pepper	Sarawak Black	Malaysia	–	Dollar/M.T	–	7300.00								
(Black)	label			Rs./Qtl.	–	39763.10	–	–	–	–	–	–	–	–
Rapeseed	Canola	Canada	Winni-	Can	605.80	644.20	638.00	637.60	640.50	613.10	505.20	527.40	484.90	493.40
			peg	Dollar/M.T	3244.06	3448.40	3415.21	3388.84	3505.46	3521.65	2895.81	3372.20	2903.10	2910.57
	U.K. delivered	U.K.	—	Pound/M.T.	379.00	389.00	393.00	394.00	375.00	330.00	318.00	320.00	290.00	303.00
	rapeseed, delivered			Rs./Qtl.	3210.89	3233.76	3233.60	3297.78	3219.75	3030.72	2883.94	3344.00	2871.00	3016.37
Rapeseed	Refined bleache-	U.K.	—	Pound/M.T.	871.00	908.00	867.00	819.00	855.00	826.00	731.00	752.00	693.00	688.00
Oil	ed and deodorised			Rs/Qtl.	7379.11	7548.20	7133.68	6855.03	7341.03	7585.98	6629.44	7858.40	6860.70	6849.04
Soyabean	U.K. produc-	U.K.	—	Pound/M.T.	351.00	379.00	376.00		409.00	395.00	422.00	426.00	393.00	432.00
Meal	ed 49% oil & protein			Rs./Qtl.	2973.67	3150.63	3093.73	–	3511.67	3627.68	3827.12	4451.70	3890.70	4300.56
Soyabean		U.S.A.	—	C/lbs Rs./Qtl.	52.03	52.07	50.82	49.18	48.63	46.63	44.26	44.31	41.82	41.50
Oil					6155.71	6251.10	6092.08	5877.05	6042.84	6185.88	5751.49	6581.26	6589.73	5620.59
	Refined bleach-	U.K.	—	Pound/M.T.	826.00	849.00	839.00	768.00	774.00	716.00	720.00	758.00	704.00	716.00
	ed and deodorised			Rs/Qtl.	6997.87	7057.74	6903.29	6428.16	6645.56	6575.74	6529.68	7921.10	6969.60	7127.78
Soyabeans	U.S.	Nether-	Chic-	Dollar/M.T.	596.70	594.10	580.10	569.20	510.10	513.00	511.50	561.70	573.70	549.20
	No. 2 yellow	lands	ago	Rs./Qtl	3203.09	3236.06	3155.16	3086.20	2875.94	3087.75	3015.80	3785.30	3541.45	3374.83
		U.S.A.	–	C/60 labs	1437.00	1482.75	1453.75	1345.25	1501.75	1534.25	1392.50	1433.00	1321.75	1310.00
				Rs./Qtl	2830.97	2964.09	2901.85	2676.88	3107.34	3389.12	3013.14	3544.11	2994.41	2954.33
Sunflower	Refined bleach-	U.K.	—	Pound/M.T.	983.00	1018.00	963.00	934.00	845.00	787.00	843.00	829.00	731.00	731.00
Seed Oil	ed and deodorised			Rs./Qtl	8327.98	8462.63	7923.56	7817.58	7255.17	7227.81	7645.17	8663.05	7236.90	7277.11
Tallow	High grade	U.K.	Lon-	Pound/M.T.	550.00	460.00	440.00	440.00	440.00	440.00	445.00	445.00	445.00	445.00
	delivered		don	Rs./Qtl	4659.60	3823.98	3620.32	3682.80	3777.84	4040.96	4035.71	4650.25	4405.50	4429.98
Turmeric	Madras finger	India	—	Dollar/M.T.	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00
	spot/cif			Rs./Qtl	4562.80	4629.95	4623.15	4608.70	4792.30	5116.15	5011.60	5728.15	5247.05	5223.25
Walnuts	Indian light	U.K.	—	Pound/M.T.	7500.00	7500.00	7950.00	7750.00	7980.00	7980.00	7800.00	7800.00	7800.00	8330.00
	halves			Rs./Qtl	63540.00	62347.50	65412.60	64867.50	68516.28	73288.32	70738.20	81510.00	77220.00	82925.15
Wheat		U.S.A.	Chic-	C/60 lbs	774.75	738.50	736.75	691.75	702.75	667.00	653.20	646.50	670.50	701.75
			ago	Rs../Qtl	1526.30	1476.30	1470.64	1376.50	1454.09	1473.38	1413.52	1598.93	1519.01	1582.60

Source : Public Ledger.

Exchange Rate

	Jan.	Feb.	Mar.	Apr.	May	June	Jul	Aug.	Sep.	Oct.
US Dollar	53.68	54.47	54.39	54.22	56.38	60.19	58.96	67.39	61.73	61.45
CAN Dollar	53.55	53.53	53.53	53.15	54.74	57.44	57.32	63.94	59.87	58.99
UK Pound	84.72	83.13	82.28	83.70	85.86	91.84	90.69	104.50	99.00	99.55

C. CROP PRODUCTION

4. Sowing and Harvesting Operations Normally in Progress During the Month of December, 2013

State	Sowing	Harvesting
(1)	(2)	(3)
Andhra Pradesh	Summer Rice, Jowar (R), Maize (R), Ragi, Small Millets (R), Gram, Urad (R), Mung (R).	Winter Rice, Urad (K), Bajra, Ragi (K), Small Millets (K), Sugarcane, Ginger, Mesta, Sweet Potato, Groundnut, Nigerseed, Onion.
Assam	Wheat.	Winter Rice, Sugarcane, Castorseed, Sesamum.
Bihar	Wheat, Barley, Gram, Winter Potato (Plains), Sugarcane, Linseed	Winter Rice. Jowar (K), Bajra, Winter Potato (Plains), Groundnut, Cotton.
Gujarat	Winter Potato (Hills), Sugarcane, Onion.	Winter Rice, Jowar (K), Sugarcane, Ginger, Chillies (Dry), Tobacco, Castorseed, Sesamum Cotton, Turmeric.
Himachal Pradesh	Onion	Sugarcane, Ginger, Chillies (Dry), Cotton, Turmeric.
Jammu & Kashmir	Onion	Winter Potato (Plains), Sugarcane, Ginger, Chillies (Dry), Sesamum.
Karnataka	Summer Rice, Gram, Urad (R), Mung (R), Winter Potato (Plains), Summer Potato (Plains), Sugarcane, Onion.	Summer Rice, Gram, Urad (R), Mung (R), Ragi, Small Millets (K), Gram, Tur (K), Urad (K), Mung (K), Other Kharif Pulses, Winter Potato (Plains), Summer Potato (Plains), Sugarcane, Chillies (Dry), Tobacco, Groundnut, Castorseed, Sesamum, Cotton, Mesta, Sweet Potato, Sannhemp, Nigerseed, Kardiseed, Tapioca.
Kerala	Summer Rice, Sugarcane, Sesamum (3rd Crop), Sweet Potato (3rd Crop.)	Winter, Rice, Ragi, Small Millets (R), Tur (R), Other Kharif Pulses, Other Rabi Pulses, Sugarcane, Ginger, Pepper Black, Sesamum (2nd Crops), Sweet Potato (2nd Crop), Turmeric, Tapioca.
Madhya Pradesh	Winter Potato (Hills), Sugarcane, Castorseed, Onion.	Autumn Rice, Jowar (K), Bajra, Small Millets (K), Tur (K), Mung (R), Other Rabi Pulses, Summer Potato (Plains), Chillies (Dry), Tobacco, Ginger, Sugarcane, Castorseed, Sesamum, Cotton, Jute, Mesta, Sweet Potato, Turmeric, Sannhemp, Nigerseed.
Maharashtra	Maize (R), Other Rabi Pulses, Sugarcane, Onion.	Winter Rice, Jowar (K), Small Millets (K), Sugarcane, Chillies (Dry), Groundnut, Sesamum, Cotton, Sannhemp, Nigerseed.
Manipur	—	Winter Rice, Sweet Potato.
Orissa	Summer Rice, Bajra (R), Urad (R), Mung (R), Chillies (Dry), Rape & Mustard, Cotton (Late).	Winter Rice, Sugarcane, Chillies (Dry), Tobacco, Groundnut, Castorseed, Cotton (Early) Mesta, Nigerseed.
Punjab and Haryana	Wheat, Barley. Winter Potato (Plains), Tobacco, Onion.	Summer Potato, Sugarcane, Ginger, Chillies (Dry), Groundnut, Cotton, Sweet Potato, Turmeric, Sannhemp.
Rajasthan	Wheat, Barley, Tobacco (3rd Crops).	Autumn Rice, Jowar (K), Small Millets (K), Tur (K), Urad (K), Mung (K), other Kharif Pulses, Winter Potato (Plains), Sugarcane, Chillies (Dry), Tobacco, Groundnut, Sesamum, Cotton.
Tamil Nadu	Winter Rice, Jowar (R), Bajra, Tur (R), Other Rabi Pulses (Kulthi), Winter Potato (Hills), Sugarcane, Chillies (Dry), Tobacco, Onion .	Autumn Rice, Jowar (K), Bajra, Ragi, Small Millets (K), Gram, Tur (K), Mung (K), Winter Potato (Hills), Sugarcane, Pepper Black, Chillies (Dry), Groundnut, Castorseed, Sesamum, Cotton, Onion, Tapioca.
Tripura	Summer Rice. Urad (R), Mung (R), Other Rabi Pulses, Winter Potato (Plains), Chillies (Dry), Tobacco.	Winter Rice, Sugarcane, Cotton.
Uttar Pradesh	Wheat, Winter Potato (Hills), Sugarcane, Tobacco, Onion.	Winter Rice, Jowar (K), Tur (K), Winter Potato (Plains), Summer Potato, Sugarcane, Groundnut, Rape & Mustard, Cotton, Sweet Potato, Tapioca.
West Bengal	Summer Rice, Wheat, Gram, Urad (R), Mung (R), Other Rabi Pulses, Sugarcane, Tobacco, Chillies (Dry).	Winter Rice, Tur (K), Urad (K), Mung (R), other Rabi Pulses, Sugarcane, Ginger, Chillies (Dry) Sesamum, Mesta.
Delhi	Tobacco.	Sugarcane
Andaman & Nicobar Island		Winter Rice

(K)—Kharif. (R)—Rabi.

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